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CONTENTS.

An Asterisk (*) denotes an illustrated article.

OFFICIAL NOTICES—

Wrinkle Department Western Gas Association 361

Seventeenth Annual Meeting, Ohio Gas Light Association 361

EDITORIALS—

Briefly Told 362

A Sad Home Coming—Mr. A. B. Slater Removed from Duty by the Providence (R. I.) Gas Company—Notes.

Proceedings, Thirty-first Annual Meeting, New England Association of Gas Engineers.—Official Report.—Revised by the Secretary—Continued from Page 330 362

First Day, Afternoon Session—A Query from the Question Box—*A Test of a Gas Engine Electric Lighting Plant, by Mr. H. N. Cheney—Discussion—Another Try at the Question Box—*Some Sketches of Gas Governors, by Mr. J. J. Humphreys, Jr.—Discussion—Report of the Nominating Committee—Election of Officers.

*Improvement in Orsat Apparatus, by Mr. A. Bement 372

Shop Organization and Bookkeeping 372

Cost of Electric Current in Massachusetts 373

ITEMS OF INTEREST FROM VARIOUS LOCALITIES 373

Amended Charter, Petersburg (Va.) Company—Bidding for the Morristown (N. J.) Company—American Gas Light Association Pipe and Fittings Standards—Proposed Opposition for Fort Smith, Ark.—Mr. Paul Challis Goes to Battle Creek, Mich.—Mr. J. C. Ernst Elected President of the Covington (Ky.) Company—Contract for the American Bridge Company—Officers Elected, Erie (Pa.) Company—Consolidation of Lighting Interests, Tonawanda, N. Y.—Proposed Company for Groton, Conn.—The Dover, N. J., Proposed Company—Changes in Management, Waynesboro (Pa.) Company—Another Opposition Company for San Francisco—Ditto, Denver, Col.—New Holder for the Vineland (N. J.) Company—Public Lighting, Columbia, S. C.—And Other Items.

The Market for Gas Securities 375

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

To the Members of the Western Gas Association—Gentlemen: The season is approaching for the collection of Wrinkles for the current year for presentation to the Western Gas Association at its coming meeting. All members and friends of the Association are reminded and invited to kindly forward, to the Wrinkle Editor as below, such ideas and devices as are suitable for this Department of the Association's work. F. H. SHELTON, No. 112 North Broad street, Philadelphia.

[OFFICIAL NOTICE.]

Seventeenth Annual Meeting, Ohio Gas Light Association.

OFFICE OF THE SECRETARY,
DELAWARE, OHIO, FEBRUARY 14, 1901.

The 17th annual meeting of the Ohio Gas Light Association will be held at Dayton, Ohio, March 20th and 21st, 1901.

The Hotel Beckel has been selected as the headquarters of the Association, and the business sessions will be conducted in assembly hall of the National Cash Register Company, one block distant from the Hotel.

The President, Mr. George Whysall, of Springfield, Ohio, will call the meeting to order on Wednesday, March 20th, at 9:30 A. M.

The following papers will be presented:

"Some Observations, Pessimistic and Otherwise;" by Mr. Charles R. Faben, Jr., Toledo, Ohio.

"Gas Pumping Stations;" by Mr. E. E. Eysenbach, Columbus, Ohio.

"Business Outside the Usual Channel;" by Mr. F. W. Stone, Ashtabula, Ohio.

"The Proportional Station Meter;" by Mr. George W. Barnes, Pittsburg, Pa.

"More about Concrete Tanks;" by Mr. C. W. Andrews, Hamilton, Ohio.

Two new attractions, which should prove most interesting, have been created for this meeting, viz.: A "Wrinkle Department;" edited by Mr. Henry L. Doherty, of Denver, Col.; and a "Novelty Advertising Department," edited by Mr. B. W. Perkins, of South Bend, Ind.

The Question Box will be given special consideration. Each member is requested to make contributions for it and send them to the Secretary not later than March 6th, so that they may be printed.

An opportunity will be given any of the speakers at the meeting to correct their remarks before leaving Dayton, but not after; as all the reports will be turned over to the printers immediately after the adjournment of the meeting.

The Hotel Beckel is conducted on the American plan and the rates for the meeting will be: $2.50 to $4 per day. The Beckel hopes to entertain nearly all of the Association, and will put forth every effort to make the members comfortable. Other hotels, the Phillips, Atlas and Algonquin, are within a block of the Beckel, and their rates are from $2 to $3 per day, American plan. The most satisfactory quarters are always obtained by writing in advance to the hotel people.

The Secretary will furnish with pleasure application blanks for membership, and any further information which may be desired relative to the meeting.

T. C. JONES, Secretary.

LIBRARY OF CONGRESS
MAR 11 1901

BRIEFLY TOLD.

A Sad Home Coming.—Mr. Alexander C. Humphreys arrived home on the "Lucania," the 3d inst., coming, by way of Europe, from Egypt, where his trip abroad was so abruptly ended by the terrible accident which resulted in the death of his two sons. While we know full well that, in such a sorrow as has fallen upon Mr. Humphreys and his family, the expressions of sympathy they have received from his professional brothers, from one end of the world to the other, cannot lighten their grief, yet in that sad journey home the sympathy and kindness offered to him and his family have been a great source of comfort. And we know that we are reflecting his wishes when we say to our readers he deeply appreciates the sympathy which has been so freely extended to him.

Mr. A. B. Slater Relieved from Duty by the Providence (R. I.) Gas Company.—The annual meeting of the Providence Gas Company was held last Monday, and during its continuance some remarkable results were reached. Ex Governor Royal C. Taft, who had been President of the Company since 1893, declined a re election, and in his place was selected John W. Ellis, of Woonsocket, R. I., who has been on the Company's Board for a bit over a year. In addition to the Presidency the new incumbent will take on the duties of General Manager to the Company. Wm. P. Nye, who has been bookkeeper to the Company for quite some time, was elected Secretary and Treasurer, succeeding Mr. Alpheus B. Slater, who held the named dual position since 1870, and whose actual service with the Company dates from 1853. Mr. Slater was succeeded on the Board of Directors by R. H. I. Goddard. The remaining "executive" officer is the Vice-President, William Goddard. Our account of the meeting of the shareholders was obtained from the columns of the Providence *Journal*, dated March 5th, and that paper, in asking President Ellis respecting the reasons which caused such radical changes in the management of the Company, reports him as having said: "It can be stated that these changes mean merely a reorganization of the methods and management of the Company. This Company is like any old corporation, and the idea is to systematize its affairs and to bring its methods of doing business up-to date." The new President, we understand, is a civil engineer of one sort or another, and that he has had quite a trifle to do with railroad engineering, and the "engineering" of the public works of a few small places. So far as gas practice goes it is understood that he had something to do with the "reorganization" of the Woonsocket Gas Company, that he was more or less concerned in the placing of a 16-inch gas main under the Seekonk river, for the supply of gas to East Providence, and that he recently had charge of "the rebuilding" of the foundations of "one of the Company's gasholders." These are successes which we hope will inspire him to greater deeds in the gas engineering line. Meanwhile the Providence *Journal* says that the new President proposes to bring the Company's "business methods up to-date;" but we think if he manages to hold them where they are he will be doing quite well. It must be much of a satisfaction to Mr. Slater, who is thus unceremoniously retired after a stewardship as Treasurer of 31 years, to know that the Company, which was a sufficiently ramshackle affair in 1871, is paying its proprietors 8 per cent. per annum in dividends, and that its stock is worth in open market quite above twice its par value. If President Ellis is careful he may keep it up to past date. When Mr. Slater was appealed to for a reason explanatory of his retirement, the clever old veteran that he is, simply replied: "The Board of Directors met some time ago, decided upon a reorganization, and this is the result of it. There is nothing more to be said, I think." Speaking for ourselves, no matter what the reasons were that prompted or caused Mr. Slater's retirement, we know that no other 10 men ever prominently connected with the Company's management did one-tenth as much for its advancement as was done by him.

Notes.—In the Journal for February 25, in our presentation of the names of new members elected at the last annual meeting of the New England Association of Gas Engineers, we reported that Mr. William R. Plunkett was the Treasurer of the Falls River (Mass.) Gas Works Company. Mr. Plunkett in reality is the Treasurer of the Pittsfield (Mass.) Coal Gas Light Company.——At the annual meeting of the Wilmington (Del.) Coal Gas Company, the Directors elected were: Messrs. Edward Betts, Wash. Jones, Jacob Derickson, Geo. S. Capelle, Thos. Jackson, E. Bringhurst, Jr., S. Bancroft, Jr., A. D. Poole and H. C. Jones.

[Official Report.—Revised by the Secretary.—Continued from Page 330.]

PROCEEDINGS, THIRTY-FIRST ANNUAL MEETING, NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Held at Young's Hotel, Boston, Mass., Feb. 19 and 20, 1901.

First Day, Feb. 19—Afternoon Session.

The Association reassembled in afternoon session, pursuant to the motion for recess. The President announced that the first business in order would be another try at the Question Box.

The Secretary read the following query:

"What is the proper size of mesh in coke screens through which the breeze should pass?"

Continuing, the Secretary said: I am not the author of the question, but as the matter of coke handling and crushing plants has concerned me not a little, I have been looking around to find an ideal system. In our part of the country it is my impression very little is being done, except in a limited way, with the crushing and screening of the coke by machinery. I thought perhaps this question might bring out some discussion as to the best arrangement of screens and number of sizes into which the coke should be divided, etc. I am sorry I have not any information to give upon it.

The President—This subject seems not to attract much attention. Evidently it is too soon after dinner. We will revert to it later. Perhaps we might better go on with the papers. I will ask Mr. H. N. Cheney, of Boston, Mass., to read his paper on

A TEST OF A GAS ENGINE ELECTRIC LIGHTING PLANT.

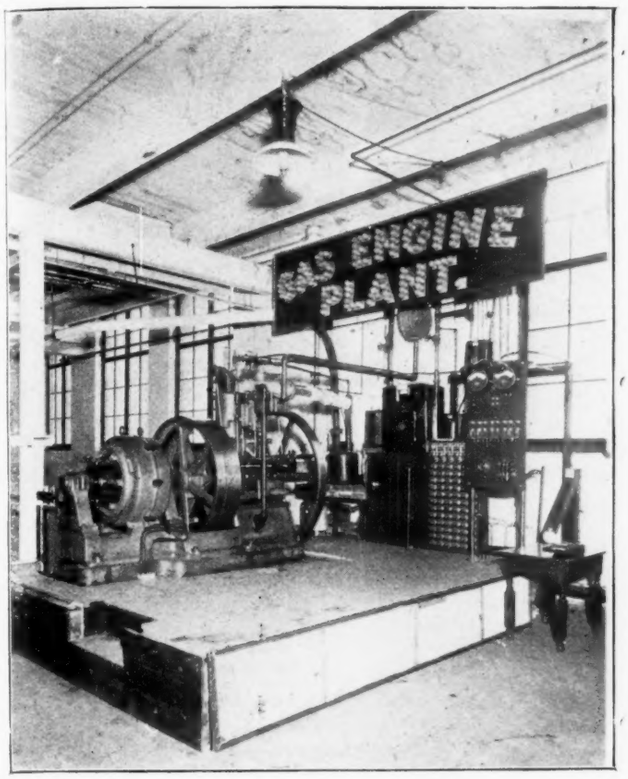
The purpose of this paper is to describe the test of a gas engine electric lighting plant, made January 2d, 3d, 4th, 5th and 9th, 1901, at the Mechanics' Building, Boston. The plant was used for exhibition purposes, at a fair held last November at Mechanics' Building, Huntington avenue, where the engine still stands.

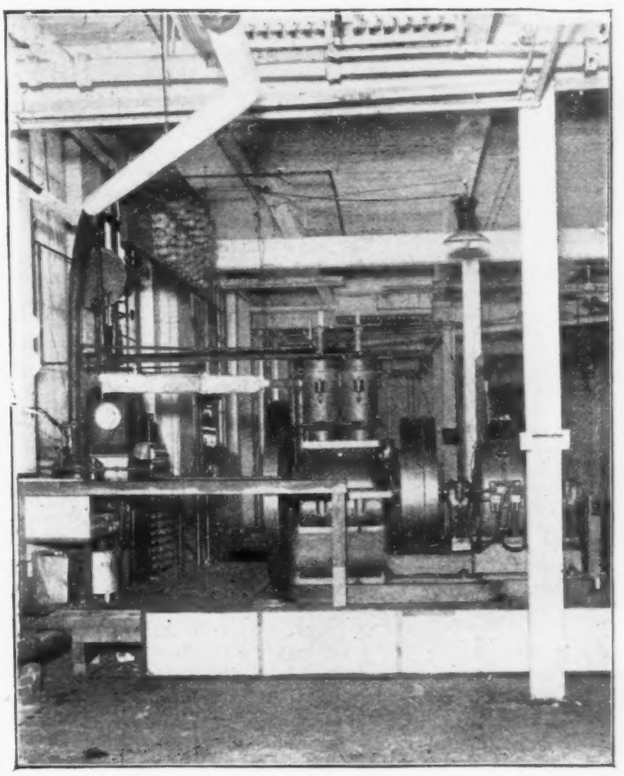
The test was made, at the request of Mr. W. R. Addicks, by a board of four, all connected with the Boston or Brookline Gas Light Companies. Mr. G. E. Whitney, of the Boston Company, was in general charge, and to him belongs all the credit for the successful carrying out of the experiment, and for the systematic and thorough manner in which the results were calculated and checked. Mr. P. H. Baker, of the Boston Company, was in charge of the chemical analyses, and Mr. P. C. Brown, of the electrical department of the Brookline Company, took charge of the electrical machinery and instruments.

The engine tested is rated at 20 horse power. It has two vertical cylinders with trunk pistons. The cranks are set 180°, thus causing the working strokes of both pistons to come in the same revolution which is followed by a revolution with no working stroke. The cranks are inclosed and dip into oil at each stroke. The governor is of the missed admission type. The strength of mixture of gas and air is regulated by a screw which determines the lift of a check valve on the gas supply pipe. There are two valves to each cylinder—the exhaust valve, and the admission valve for gas and air—which both open once every two revolutions. One valve on each cylinder admits gas to the air supply pipe just in front of the main admission valve. Whether or not this valve opens depends on the position of the governor. The valves are operated from cams on a shaft running parallel to the crankshaft and at ½ its speed. A starting lever is provided, which, when thrown down and locked, keeps the exhaust valve of 1 cylinder open during ½ of the compression stroke, and the exhaust valve of the other cylinder open continually. The engine is fitted with both electric and hot tube igniters. Both the sides and heads of the cylinders are water jacketed, the water entering at the bottom direct from the city main and flowing out of the cylinder heads, from whence it is led to the exhaust pipe a few feet in front of the exhaust muffler. From the bottom of the muffler the water flows to waste. During the experiment the piping was so arranged that a part of the jacket water could be turned into the exhaust pipe close to the exhaust valve. This was found to make the engine run with much less noise from the exhaust, and all the tests were made with the water flowing in this way.

The engine is direct connected through a friction clutch, with a Lundell dynamo. It is a 6 pole machine, and is rated at 12.5 kw., 122 volts, 100 amperes at 280 revolutions per minute.

The friction clutch is intended to prevent the dynamo from following the engine too closely in the changes in speed which occur during each cycle. It consists of 3 leather covered shoes attached to the





dynamo shaft, or, more properly, to a flywheel on the dynamo shaft, and bearing on the inner face of a pulley on the engine shaft. The shoes are pressed outward by springs, acting on them through levers which are prolonged in such a way that the centrifugal force in them tends to counteract the springs.

The load carried in the test was made up of 16 candle power, 110 volt, incandescent lights, in the form of a sign and also in a bank, all controlled by suitable switches. The principal dimensions of the engine and dynamo are as follows:

Number of cylinders		2
Diameter of cylinders, inches		7.5
Length of stroke, inches		10
Clearance volumes, cubic inches	152.2	158.8
Compression, atmospheres (estimated)	6 75	6.5
Length of trunk piston, inches		15.25
Length of connecting rod, inches		25
Diameter of " " "		1.5
Crank pin, length, inches		3
" diameter, "		3⅝
Crank web, breadth, "		5
" thickness, "		2
Crank shaft, diameter, inches		2 7/16
" length of outside bearings, inches		6
" length of center bearing, "		5
" center to center of bearings, "		12.5
Flywheel, diameter, feet		5
" width of face, inches		4.5
" thickness of rim, "		2
Friction clutch, diameter, feet		4
" width of face, inches		6.75
" thickness of rim, inches		1
" shoes, number		3
" " length, inches		6
" " breadth, "		3
Dynamo flywheel, diameter, feet		4
" " width of face, inches		4
" " thickness of rim, inches		2.5
Armature shaft, diameter, inches		2½
" length of bearings, inches		8
" center to center of bearings, ft. and ins		2 9
Cam shaft, diameter, inches		1.5
" gear, diameter, inches		16
" width of face, "		1.75
" pinion, diameter, "		.08
" " width of face, inches		1.75
Valve rods, diameter, inches		⅝
Bedplate, length, feet and inches		7 6
" greatest width, feet and inches		4 0
Extreme height of engine, "		6 8
" length of engine, "		8 2
" width of engine, "		5 0

The pipe connections to engine are as follows:

Gas.	From service to meter, length, 35 feet	Size, 1.5 inch.
	Meter	" 80 light.
	Meter to engine, length, 21 feet	" 2 inch.
	Gas bag, diameter of diaphragm, 18 in., depth, 6 in.	
	Supply pipe for hot tube igniter	Size, ½ "
Air.	From engine base to inlet chest, 4 feet	" 1.5 "
Water.	All connections	" ¾ "
	Meter	" ½ "
Exhaust.	From engine to muffler, length 6 feet	" 2.5 "
	" 2 "	" 3 "
	From muffler " 105 "	" 3 "
	" 145 "	" 2.5 "

In fitting the plant for testing a wattmeter was set up to measure the output of the dynamo. The ammeter on the switchboard was tested and used. The voltage was measured with a portable volt measure. The gas meter and water meter were those which had been used with the engine. Thermometers were placed in the inlet to gas meter, and inlet to water meter, in the discharge from the jacket of each cylinder, and in the jacket water discharge pipe. A recording pressure gauge was placed at inlet to meter. A mercury gauge was placed at the exhaust muffler. Revolution counters were attached to the engine and to the dynamo, and counters were also attached to each gas inlet valve.

Five 6 hour tests of the plant were made at different loads. These loads were, nearly: Full load, three-quarter, half, one-quarter, and no load for the dynamo. The tests were conducted in the following manner. The engine was started with electric ignition and run with the load it was intended to carry throughout the test until the conditions became fairly constant. Then the test was commenced and readings of the various instruments taken every 10 minutes for 3 hours. At the end of this time the burners at the hot tube igniters were lighted and 10 minutes later a second 3-hour run was commenced, the electric igniters having been thrown out of service.

Several tests were also made of the regulation of the engine and dynamo. The load was suddenly changed by pulling out or throwing in switches. For three minutes before this change, and for 6 or 7 minutes after it, simultaneous readings were taken, at 1 minute intervals, of the voltmeter, ammeter, revolution counter on engine, and the revolution counter on dynamo. Principal results of the tests are shown in the following table:

Load.	Full.		Three Quarter.		Half.	
Kind of Ignition.	Elec.	Tube.	Elec.	Tube.	Elec.	Tube.
Cubic feet gas per hour, 60° F.	400.5	407.0	302.1	321.2	233.0	248.3
Temperature, inlet to meter	82.	82.82	75.	75.	71.	72.
Cubic feet water per hour	11.71	12.02	8.50	8.20	5.57	6.76
Cubic feet water per 1,000 feet gas	29.3	29.5	28.2	25.5	23.9	27.2
Cubic feet water raised 1° F. per 1,000 cubic feet gas	4,230.	4,460.	3,968.	4,110.	3,550.	3,810.
Temperature, jacket water, inlet	48.	48.	48.	49.	49.	49.
" " " discharge	192.	199.	189.	207.	198.	189.
Revolutions per minute, engine	284.9	283.0	287.8	287.2	289.5	289.8
" " " dynamo	272.4	271.3	275.1	275.4	279.1	278.6
Gas inlets, per minute	280.0	278.7	215.1	230.9	191.7	177.6
Possible gas inlets, per minute	284.9	283.0	287.8	287.2	289.5	289.8
Volts	109.8	109.8	110.1	110.0	110.0	110.0
Amperes	101.2	101.0	76.0	76.0	51.0	51.1
Kw. (by meter)	11.4	11.4	8.4	8.5	5.6	5.6
Dynamo output in horse power	15.29	15.29	11.25	11.35	7.55	7.58
Efficiency of dynamo	.831	.831	.821	.821	.787	.787
Dynamo input, in horse power	18.39	18.39	13.70	13.81	9.59	9.63
Kw. hours, per 1,000 cubic feet gas	28.5	27.9	27.8	26.4	24.2	22.8
Cubic feet gas, per kw. hour	35.1	35.8	36.0	37.9	41.3	43.8
Dynamo input, horse power hours, per 1,000 cubic feet gas.	46.0	45.1	45.4	43.0	41.2	38.8
Cubic feet gas per dynamo input, horse power hours	21.75	22.2	22.0	23.3	24.3	25.8
B.T.U. per cubic feet gas—						
Useful work	98.	96.	95.4	90.5	86.5	78.0
Dynamo loss	19.9	19.4	26.0	19.7	23.3	21.2
Jacket water	265.	278.	248.	252.	233.	238.
Calorific value	558.9	561.2	582.7	573.7	582.7	566.4
Percentage heat distribution—						
Useful work	17.5	17.1	16.3	15.7	14.8	13.8
Dynamo loss	3.6	3.5	3.5	3.4	4.0	3.7
Total dynamo input	21.1	20.6	19.8	19.1	18.8	17.5
Jacket water	47.3	49.6	42.6	43.9	38.2	42.1
Unaccounted-for	36.1	29.8	37.6	37.0	43.0	40.4

Load—	One Quarter		No Load	
Kind of Ignition.	Elec.	Tube.	Elec.	Tube.
Cubic feet gas per hour, 60° F.	164.6	204.0	78.1	109.8
Temp. inlet to meter	73.0	73.0	73.0	71.0
Cubic feet water per hour	4.17	6.15	1.45	1.45
Cubic feet water per 1,000 feet gas.	25.3	30.1	18.3	13.4
Cubic feet water raised 1° F., per 1,000 cubic feet gas	3,360	3,940	2,270	1,890
Temp. jacket water, inlet	49	49	58	57
" " discharge	182	181	182	200
Rev. per min., engine	290.7	290.2	292.6	290.9
" " dynamo.	282.9	283.2	290.8	289.4
Gas inlet, per minute	137.8	167.4	50.9	62.4
Possible gas inlets, per minute	290.7	290.2	292.6	290.9
Volts	109.9	109.9		
Amperes	26.0	26.0		
Kw. (by meter)	2.7	2.8		
Dynamo output, in horse power	3.66	3.75		
Efficiency of dynamo	.681	.681		
Dynamo input, in horse power	5.37	5.51		
Kw. hours per 1,000 cubic feet gas.	16.5	13.7		
Cubic feet gas per kw. hour	60.3	73.0		
Dynamo input, horse power hours, per 1,000 cubic feet gas	32.7	27.0		
Cubic feet gas per dynamo input, horse power hours	31.2	37.0		
B.T.U. per cubic foot gas—				
Useful work	56.8	47.1		
Dynamo loss	26.6	22.0		
Jacket water	210.0	247.0	144.0	119.0
Calorific value	577.0	588.0	576.4	567.1
Percentage heat distribution—				
Useful work	9.8	8.0		
Dynamo loss	4.6	3.8		
Total dynamo input	14.4	11.8		
Jacket water	36.4	42.0	24.7	20.9
Unaccounted-for	49.2	46.2		

The cubic feet per kw. hour I have plotted against the load in kw. A glance at these curves shows at once a considerable difference in economy with the different kinds of ignition. This difference is always in favor of the electric igniter. In making up the table and plotting the curves no account was taken of the gas used to heat the ignition tubes. This should not be charged to gas consumption, although it would appear in the gas bill. In comparing the two forms of igniter it should be set opposite to the cost of maintenance of the batteries, etc., for the electric igniter. The curves bring out very strongly the disadvantage of operating the plant at light load.

The great majority of gas engines at present are used for power purposes as distinguished from electric lighting. Therefore it seems worth while to plot the curves of gas per horse power hour against horse power. The horse power in this case is the input to the dynamo which, owing to the loss in the friction clutch, is somewhat less than the output of the engine. The horse power is figured from the dynamo output by the use of the generator efficiencies furnished by the makers. These curves show practically the same things as the curves of cubic feet of gas per kw. hour, except that the consumption at full load holds more nearly for the other loads, owing to the different efficiencies of the dynamo.

In general the plant ran very well. No trouble was experienced in starting. No attention was necessary while running with the electrical ignition. With the hot tube ignition some slight attention was necesary. For some reason, perhaps late ignition and slow burning of the charge in cylinder, the mixture would sometimes become ignited as it was entering the cylinder and explode back into the base. This necessitated changing the strength of mixture.

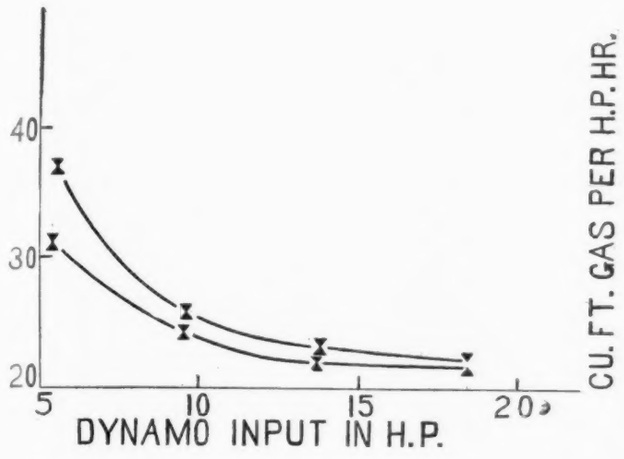
In view of the difference between the results obtained, using electric ignition and those obtained using hot tube ignition, it is a pity that indicators could not have been put on the engine to determine the points of ignition. No good way was found to attach them, however, without danger of injuring the engine.

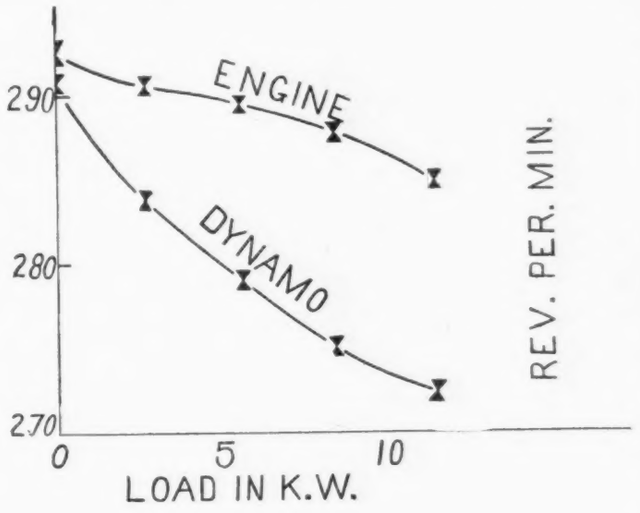
Now, in regard to the regulation of the engine and dynamo. Let us glance at the curves of revolutions per minute against load and kw. The revolutions of the engine decrease as the load increases. From one quarter to full load there is a variation of about 6 revolutions per minute, or about 2 per cent. In the revolutions of the dynamo there is a much greater change. From one-quarter to full load it is about 11½ revolutions per minute, or about 4 per cent. Another curve which brings out the same thing, is one formed by plotting the slip, or difference between revolutions of the engine and revolutions of the dynamo, against the gas inlets per minute. This shows that the slip increases as the gas inlets per minute increase, or as the load increases.

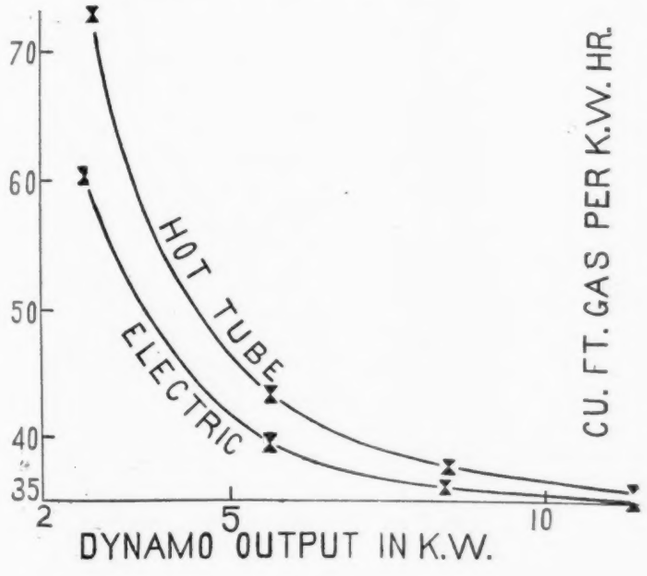
From this it is seen that the friction clutch is in a certain way detrimental to the regulation of the voltage, since it permits the dynamo to vary in speed more than the engine does. It effects its purpose of preventing the dynamo from following the engine in the variations in speed which occur during a cycle, but it does so at the expense of good voltage regulation under a varying load. I am told that this fault can be corrected by changing the winding of the dynamo fields in such a way that the voltage will not rise with the increase of speed. The dynamo tested is specially wound with, I believe, this end in view, and it may be that, had it been run at its rated voltage of 122 instead of 110, the remedy would have proved successful. As it was, this special winding apparently did not improve matters very much, as the following results of the regulation tests show a change in voltage nearly proportional to the change in speed.

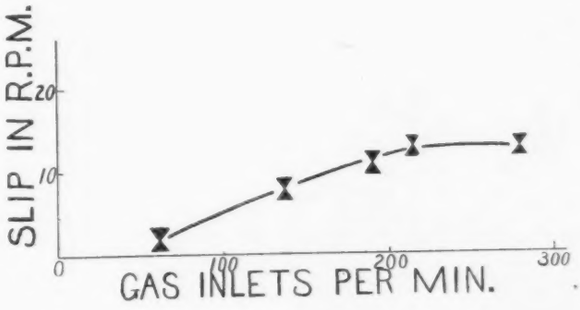
100 amperes....110 volts. changed to 75 amperes....112½ volts.	75 amperes....110 volts. changed to 100 amperes....108 volts.

50	amperes....	113½ volts.	50	amperes....	111½ volts.
25	"	115 "	25	"	113 "
10	"	117 "	10	"	115 "
50	"	110 "	10	"	110 "
	changed to			changed to	
100	amperes....	107½ volts.	100	amperes....	108 volts.
75	"	108½ "	75	"	110 "
25	"	110½ "	50	"	111 "
10	"	111½ "	25	" ..	110 "









The cost of the plant is as follows:

Engine, including exhaust muffler, gas bag, batteries, spark coil	$1,050
Dynamo, specially wound, including rheostat	550
Switchboard and connections to dynamo, including 4 circuit switches, circuit breaker, voltmeter, ammeter lamps for each, 2-pole igniter switch, place for rheostat, made of 1 inch slate, price	150
Total cost	$1,750

The cost of installation, added to the cost of machinery, makes the total cost of the plant a little more than $2,000. From some figures the builder's agent was kind enough to show me, the cost of installation of the engine alone would average about $10 per horse power. Thus, if the engine were to be used for power, it might be installed for $1,250, though, of course, that would depend largely on location. The interest and depreciation, a percentage of the first cost, make a cost which must be charged against the plant practically irrespective of the time of operation.

The greatest amount of water used in the jacket was 12 cubic feet per hour. If the engine were to be left without attendance this amount of water should be used continually in case the load should be increased full load. The cost of water and the cost of oil, of which one quart was used in 13 hours, form a cost depending on the hours run.

Very little attendance is required by a gas engine when used for power. I recently had occasion to visit quite a number of gas engine users and to ask them, among other things, "Who tends the engine?" In a majority of cases the answer was, "No one, in particular." With the engine used to develop electricity for lighting it may require some little attention to keep the voltage constant, but this would depend upon the special conditions under which the plant was operated. Thus the cost of attendance may be practically constant, or may depend on the number of hours run, according as the engine is used for power, or for electric light with a varying load.

Now combining these three costs, the one for interest and depreciation, the one for water and oil, and the one for attendance, with the cost of gas used, which depends on the number of hours run and the load carried, it is possible to get the cost of operation per year or per horse power hour or in any other convenient form for any special case. The price of gas and water and the conditions of use vary so greatly that it is well nigh impossible to give any general figure that is of any value. It can only be said that, for stationary power service, the gas engine, with the operating expenses generally lower, possesses all the advantages of the electric motor, and for isolated electric lighting plants, up to 60 or 70-horse power, it has all the advantages that the steam engine has for larger ones.

Discussion.

The President—I know Mr. Cheney has a lot up his sleeve, and I think he can answer most of the questions fired at him. I will commence by asking Mr. Cheney one question. He said that at the varying powers the engine was run at, the constant voltage varied somewhat, and I would ask him whether, in going from full power to either three quarter, half or one-quarter power, he could observe any flicker in the lights, either going to the lower power or going from the lower power to the higher power.

Mr. Cheney—I don't remember any change in the lights.

The President—When you threw off, say half of the lights, you could not see it in the rest of the lights?

Mr. Cheney—I don't think so.

The President—Another thing referred to was the amount of water used. Of course, this water was run to the sewer, because it was not convenient to rig up a tank. You are all aware that by use of the tank we could save that water—12.2 feet I think he gave. Another thing I would like to call your attention to is the extraordinary length of the exhaust pipe, which I think was 250 to 260 feet.

Mr. Cheney—Two hundred and fifty-eight feet.

The President—A pressure gauge put on the exhaust pipe showed the back pressure to be about 12 inches.

Mr. Cheney—Half an inch of mercury.

The President—Which would be 12 or 13 inches of water. As to the noise on the exhaust. If you had been outside the building where the exhaust pipe was laid you would not have been able to say whether it was a steam pump working or a gas engine. That may seem to you an exaggeration, but that is the truth of the situation. By the way, I want to say that I can arrange for that engine to be running, for any one who wants to look it over, between 5 and 6 this afternoon and between 9 and 9:30 to morrow morning. Of course, we don't start it up if nobody wants to look at it, but if you want it it will be started up.

Mr. Pratt—Does Mr. Cheney prefer the electric spark to the tube ignition on all sizes?

Mr. Cheney—The results from this engine seem to show that the electric igniter was very much more economical than the tube igniter. I am informed that other tests have been made with exactly opposite results, but I cannot say anything in regard to them.

Mr. Walton Clark—I cannot add anything of interest to Mr. Cheney's paper, referring to questions of economy, but it will be a matter, I think, of general interest to know that we are operating the electric apparatus and lights in our office building in Philadelphia with gas engines. Our building is 170 feet high from the curb. We have to pump water to the top of the building for various purposes; we have three elevators to run and have numerous ventilating fans and electric lights We have three 90 horse power gas engines in the basement, which engines are each coupled directly and rigidly to a dynamo. We have a storage battery, with a booster, for use in charging it. All the work in the building, including pumping water, running the elevators and ventilating the building, which requires considerable power, for we try to keep it thoroughly well ventilated, is done with electricity, and this electricity is generated, as I have said, by these three gas engines. We shut down the engines about 5 in the afternoon, I think, and the battery takes care of the load until the next morning or over Sunday. These are Westinghouse engines, 3 cylinder type. I regret that we have not yet made a complete test of our power appliances and machinery, for I had hoped to read a paper about it at this meeting. One of my sons had occasion this year occasion to write a thesis, and in order that he might have opportunity of preparing himself I set up a gas engine at home, 3 horse power, belted to a 1½ kilowatt dynamo, 120 volts, and he has made a very thorough test of it. I refer to that simply to remark on the beautiful governing of the engine. Starting with one quarter horse power load on the brake, and running from that to all the engine would turn over, the variation in revolutions was only from 259 to 261, and there was no perceptible change in the lights with any of the variations in load when the dynamo was connected. That was a White & Middleton engine, and I don't know that it had any frills on it. We bought it in the market; and it certainly governs very closely, and is perfectly adaptable to use for electric lights. All the power used in our office building comes in through two 4-inch gas service pipes. We had at first certain troubles with the gas engines. One or two cylinders were broken; but we had ample reserve, and I believe everything now runs perfectly smooth. We expect to see a very considerable introduction of gas engines for generating electric power in office buildings in the future. I want to say in this connection that our engine room is 15° or 20° cooler in the hot weather in the summer than any other engine room of the same size in any office building that we know of, which is quite a point.

The President—That last fact is a very important point. Of course, it is not quite so cool as when you buy your electric light from the central station, but I don't suppose Mr. Clark intimates that.

Mr. Egner—In my recent travels I met a gas man who met electric competition and made a customer for gas in this way. His name is Mr. Walter Thomas, and he is Superintendent of the Vancouver Gas Company. An electric lighting company that was organized there, with a very fine plant indeed, bought the Welsbach patents, so I am informed. If a customer of the Gas Company wanted a Welsbach mantel lamp he could get one by paying $5 for it, and they would rent it to him if he would pay $3 a year. So Mr. Thomas could not beat the electric light at all with the Welsbach mantel. They tried to, but the Gas Company was sued and was fined altogether $2,000 damages, which experience ended that trial. So Mr. Thomas studied electricity and studied the gas engine. He imported gas engines and house dynamos, and hooked them up. He showed me the results. I went with him to machine shops and foundries where the gas engine had displaced the electric motors. At night time I went round with him to a number of public resorts where they often had as few as 30 incandescent electric lights up to quite a number more. He interviewed those people, and in the end would put a gas engine in the cellar to operate a little dynamo, with a small switchboard, and furnished them light. His day consumption, by the gas engines especially, was larger than his night consumption, and his summer consumption was as large as his winter consumption. When I asked, "Who takes care of the engine?" the answer was very much like that in the paper, "Anybody," but the people generally who owned or ran the places spoke in high praise of the engine. I was told how economical it was, and how much it saved in lighting bills. In that way Mr. Thomas hit the electric company very hard. He is a very energetic young man. He said every gas engine introduced sold another. He had four or five standing there. He asked me what I thought of it. I said, "Thomas, I think you are working yourself out of a job." He said, "What do you mean?" and I answered, "The electric company will be buying up the gas works, and they may put you out." "Well," he said, "That is what they are trying to do now."

Mr. W. F. Humphreys—Was that exhaust pipe used for heating? Why was that distance of exhaust pipe run?

Mr. Cheney—The engine was situated in the Mechanics' Building on the Huntington avenue side. The city officials are very particular not to have any exhaust on Huntington avenue, so it had to be carried to the back of the building. That explains the cause of its length.

Mr. F. W. Humphreys—Have you encountered any factories or places where they had been using the exhaust for heating at all?

Mr. Cheney—No.

Mr. F. W. Humphreys—For heating part of the building, or anything of that kind?

Mr. Cheney—No.

Mr. Walton Clark—Mr. President, the exhaust from our gas engines is used for heating.

The President—It is on the first and second floor, is it not?

Mr. Walton Clark—It produces heat for the first floor, the main offices.

The President—Did you use cast iron pipe for an exhaust, do you remember?

Mr. Walton Clark—No; we did not. I don't understand the clutch used between the gas engine and the dynamo in the case reported by Mr. Cheney.

The President—Will Mr. Cheney explain that in greater detail?

Mr. Cheney—(Indicating on the plan.) Between the engine and the dynamo is this pulley on the engine shaft, and this pulley right side of it on the dynamo shaft, and connected to the spokes of this flywheel on the dynamo shaft are 3 shoes that bear on the inside face of this pulley on the engine shaft and which slip around on the inside. They are held out by springs attached to the hub. The fulcrums of the levers that act on the shoes are on the arms of the flywheel.

Mr. Norris—Are these shoes supposed to slip when the engine takes a charge?

Mr. Cheney—Yes, sir.

Mr. Norris—Rather an unmechanical sort of device, it would seem at first sight.

Mr. Walton Clark—Was that a satisfactory arrangement?

Mr. Cheney—As I said in the paper the dynamo speed varied more than the engine speed.

Mr. Walton Clark—Then it was not a satisfactory arrangement?

Mr. Cheney—In some ways, yes; in others, no.

Mr. Walton Clark—When we were thinking of installing these gas engines one firm of engine builders proposed to put in a flexible shaft, not to provide for any slip, but so that any jump of the engine would put this shaft under greater tension. We did not adopt that finally. Our dynamo was connected rigidly.

Mr. Cheney—I would say that this friction clutch was tightened, so that the slip was reduced, I think, to 5 or 6 revolutions per minute. At full load there was then quite a perceptible variation of the voltage as the engine took gas.

The President—I would like to read from a test that Mr. Cheney has

not given; that is to say, the test on a particular day. This is the result of 10 minut readings on each hour of the test, for 6 hours. The revolution of the engine per minute for the first hour, 285.8; next hour, 285.1; next hour, 285.1; next hour, 284 8; next hour, 284.6; next hour, 284.9. The revolutions of the dynamo per minute for the first hour, 273.0; next hour, 272.4; next hour, 272.5; next hour, 272 1; next hour, 271.8; next hour, 272.4. You see the slip between the engine and the dynamo was practically constant, running at constant speed. Now, taking another day——

Mr. Walton Clark—I was going to say that apparently the average per hour was constant, but the question is how is it from second to second, and from half-minute to half-minute?

The President—That will be shown to some extent by the volt meter if I read the voltmeter. Mr. Cheney, at a full load run what was the maximum variation in the voltmeter from minute to minute, during the full load run, in changing the load?

Mr. Cheney—I should not say there was any variation perceptible from minute to minute. As the lamps became warm more and more and the circuit became warm there was a slight difference, but the voltmeter was absolutely steady.

The President—Does that answer Mr. Clark's question? As a matter of fact, I personally examined the voltmeter needle and could scarcely see any variation. Half a volt was the maximum variation that I could see, I think, in 10 minutes.

Mr. Walton Clark—A considerable variation was reported when the load varied.

The President—Exactly. That was on a test of dropping from full load quickly, instantaneously, down to quarter load or half load, as an extraordinary test, to see if we could notice any change in the lamps in that drop.

Mr. Walton Clark—The question in my mind is as to the efficiency of that clutch. It does not seem to me quite right. I think this is one of the most important subjects that we could discuss, and if there are any more points that can be brought out, Mr. President, I hope the question won't be dropped now. We have electricians here who should be able to give us considerable criticism of this paper.

Capt. White—Did Mr. Clark use the storage battery in Philadelphia as a means of regulating the current of the box, or just to take care of the load?

Mr. Walton Clark—The storage battery which is on what we call a spur connection was put in to take care of the night load and Sunday load. I don't mean to say that perhaps we would not need it anyway, for it certainly does govern to some extent; but our purpose in putting it in was to enable us to run the engine 10 hours a day and shut down for the rest of the day.

The President—If we keep the discussion up long enough on this line perhaps some people would like to go out and look at the gas engine. We might get their interest up to wonder what it is. As there seems to be no desire to continue the discussion further, I extend to Mr. Cheney, on behalf of the Association, its thanks for his paper and for the care with which he has looked up the subject. Our members will, I am sure enjoy looking over the data later on, which inspection will answer many of the questions asked that were possibly not fully replied to. We will now revert to the Question Box and try the query that failed of answer half an hour ago.

The Secretary—

"What is the proper size of mesh in coke screens through which the breeze should pass?"

Presumably, when the coke is crushed and passing from the crusher to the sorting of the different sizes of broken coke for sale.

Mr. Coggeshall—The size of our mesh is ¼ inch.

The Secretary—Does Mr. Coggeshall divide the broken coke into more than one size?"

Mr. Coggeshall—Apparently what we sell is all one size. It will vary some.

The Secretary—Yes; but you do not make several kinds of coke; say, pea or nut or stove coke?

Mr. Coggeshall—No.

The Secretary—The next question is:

"In coal gas manufacture, does it pay to work for highest yield, or should greatest number of candle-feet be sought for?"

The President—That should be an easy one.

Mr. Walton Clark—Suppose you try it, Mr. President.

The President—Mr. Clark, I am making coal gas just now.

Captain White—Much depends on whether or not you have Welsbach burners. To give the question a sort of send-off, Mr. President, I might say this matter is largely local in its application. The question before us could be settled did we know whether one was selling gas to a community burning its gas in ordinary burners, or using the Welsbach or other burner of the incandescent type. It is well known there is more money for a gas company to make and sell a low candle power coal gas to people who will use the Welsbach type of burner than there is in attempting to make a high candle power of coal gas for sale through the ordinary burner. The answer to the question simply resolves itself into the questions of locality and as to what is going on therein. A man who is urging the sale of Welsbach burners is simply wasting his stockholders' money in attempting to make a 20 or 25 power candle gas. Gas after all in our day is resolving itself into a question of heat units, not illuminating power, and where a man is earnestly endeavoring to give the best results to his community with the least expense to his directors, he comes to the question of the amount of gas that he can put into his town at the lowest candle power and still give its users high illumination, the people getting that illumination through the auxiliary work of incandescent lamps. It is impossible to make a law that will apply to everybody. You simply say it is a question of locality, just exactly as it is a question of locality whether a man will build a coal or a water gas works, or whether he will have a works combining both. It is largely a question of the cost of material and of labor and of conditions at that point. In this case an answer to the question becomes purely a thought as to whether he can make a cheap coal gas of low illuminating power and send it out to a community that is using largely the Welsbach lamp or a burner of that type—I simply use that as a type. I don't see how we can offer to the questioner any other answer.

Mr. Norris—I think that by assuming certain average conditions we can perhaps answer the question a little more definitely than Captain White has indicated. While sitting here I have been doing a little figuring, and have assumed as fairly representative of ordinary practice the following data: Oil at 4 cents per gallon; gas coal at $3.50 per net ton, delivered in sheds; labor, $1; residual receipts, $2.50 per net ton of coal carbonized. I have also assumed a works making a 20 candle power mixed gas, using water gas as an enricher, and that a variation in candle power of the coal gas simply means the use of more or less oil in the water gas sets without affecting other costs. In speaking of candle power I assume the use of a flat flame burner. Under the above conditions I have endeavored to figure the effect on the cost of the mixed gas of a high yield of low candle power coal gas, as compared with a lower yield of higher candle power gas, the total number of candle-feet per pound being the same in the two cases. I have, therefore, taken 5 feet of 14-candle power gas, or 70 flat candle-feet per pound, and compared it with 4⅔ feet of 15⅓ candle power gas, which also figures 70 flat candle-feet per pound, and enriched both gases to 20-candle power by using more or less oil in the water gas sets. Under these conditions I find a difference of about 2 cents per 1,000 in the cost of the enriched gas, in favor of the higher yield per pound with the lower candle power coal gas. In other words, where the deficiency in candle power can be made up by using extra oil in the water gas sets, the most economical result is obtained with a high yield of gas per pound, even though the candle power of the gas be reduced in proportion. To put it another way, with equal candle-feet per pound of coal, the higher the yield per pound the cheaper will be the mixed gas in the holder.

Mr. Egner—The question that has been put is quite a deep one. In fact it strikes me it would be a good subject for a very good paper, for in the question whether it is best to make the greatest number of candle-feet or to get a high yield, a great many things enter that a practical gas man must know. I know of works where, for instance, they have, as near as I can remember, 10 or 12 men working on the retort house floor, with a like number cleaning the chokes in the pipes. There is little economy in that. I don't want to take up your time calling attention to these practical facts, but the question itself can't be answered off hand. As I said, it is a question with matter in it for a very good paper by some able man.

Mr. Norris—I figure that under normal conditions, with hand fired benches, and with any given number of candle-feet per pound of coal, a difference in yield of one tenth of a cubic foot of gas per pound makes a difference of about one-half a cent in the cost of the gas per 1,000.

Mr. Egner—If the same number of men will do the work, of course, if you have not stopped stand pipes and other difficulties to contend with which are bound to come.

The President—Mr. Egner, the question I think has been limited to 5 feet to the pound. Mr. Norris limited it to 5 feet to the pound in his presentation, I think.

Mr. Norris—No.

The President—In your calculations you took 5 feet of gas to the pound as one limit, and 4½ feet as the other.

Mr. Norris—In my last figures I assumed the cost for labor and the yield of residuals per ton of coal carbonized remained constant, and the only variation was in the yield of gas per ton.

Mr. Coggeshall—There is too much supposition in relation to communities using gas, especially in New England, with which we are connected. We don't find any communities to whom we are supplying gas that are using all Welsbach burners. If we should send out gas of 15 candle power there would quickly be a howling round our ears. A few years ago there was a great ambition among the gas engineers to produce a large quantity of gas per pound of coal. Some of them, I think, read papers in which they showed yields of 5.41 to 5.60. Being ambitious to meet the best results I ran mine up very high, but very soon found my hydraulic main filled with pitch and the standpipes stopped. About 10 years ago I dropped down to about 5 feet to the pound, and I have since figured as near to that as I could and have had very little trouble from stoppages since.

The President—I think we had better couple on to this question another relative question, which appears later on in the list. It is:

> "Is the incandescent gas burner in sufficiently general use to warrant going back to gas of 17-candle power?"

It is intimately connected with the question as Capt. White presented it.

Capt. White—Mr. President, I may also be pardoned for repeating myself, but I have given it as my opinion, at the various meetings of the Gas Associations, that we were all making a very great mistake in training our public to these high illuminating powers, in the face of the development of incandescent lighting, and I have persistently urged that after all some man inspired by the necessities of the business, as is always the case, would yet develop how we might make great volumes of coal gas of accepted heat values in cupolas, much as we make water gas to-day; in other words, that one man instead of making a few thousand feet per day would make hundreds of thousand feet, and that this gas would not exceed 15 or 16-candle power, but it would possess all the heat values of straight coal gas. Now, I believe that, with the continually increasing competition of the electric light, the development of the electrical engineer in his field, and the consequent development of the mechanical side of the question of electric light—and you will all agree with me—that when it becomes a pure question of mechanics, which it is to-day, the American mechanic will develop and settle the question of how to obtain the greatest electrical values at the least expense. Now, as the slang of the day has it, "We are up against it." The electrical engineer is winning his spurs, also his way. The gas engineer must meet him. I believe, as I have for some years, that the developments to come in the gas industry will not be along the line of water gas or in some newly discovered process, but along the line of how to best apply what we know in the coal gas industry, how we can get the most out of a ton of coal of the greatest heat values. For, gentlemen, it is all developing itself right back as to how to get the most heat value out of the coal. And every man in this room will live to see the sale to the public, not of cubic feet but of heat value, in some form—in units, if you please, simply for a term. And, therefore, I also look for the development of the man who will furnish us an incandescent gas lamp, not in the present expensive form of the Welsbach and such type of lamps, but somebody who will give us an incandescent bulb that may be dropped over the ordinary burner, with some little arrangement for the introduction of air, which will be so very cheap that the ordinary householder can buy it at some simple price. Then we can send into the streets a 15 or 16-candle power coal gas that will give the people who don't wish to use the incandescent lamp a really good light, but those who want higher illuminating values will have a cheap means of securing this greater light value from the gas. I believe, gentlemen, that we will all be selling gas at one price, for all purposes, through one service and measured by one meter, within very few years. The development of the business compels it. And, therefore, I come back, Mr. President, in answering the question which you have coupled on to the preceding one, to my first position, that it is, after all, a local question in the one case and a development of the incandescent burner in another; and I firmly believe that every man here will live to see the development of just what I have said—the production of coal gas in great quantities through cupolas, one man producing as much coal gas practically as is now produced of water gas by the same means, that one meter and one service and one general price will answer all the purposes of the public. When we canvass our public for the use of gas it will be simply at one price; they may use it in stores or they may use it in dwellings. The answer to the question simply is founded upon the fact that, through the incandescent lamp, the result of the discoveries of Dr. Auer von Welsbach, which are illuminating the pathway for men who shall follow him, through the demand which the electrical engineers will force upon us, the gas engineer will develop a means of making a 15 or 16-candle coal gas at so cheap a price that it may be sold for all lighting and fuel purposes at a price at which your public will not care to use coal with its many annoying features.

Mr. F. C. Sherman—I would like to ask you what proportion of the burners in this city to-day are of the incandescent type.

The President—I cannot answer that question, Mr. Sherman. I endeavored to find out at the Gas Appliance Exchange how many they sent out a month, and could not get any definite information as to the city proper. From memory it was something over 1,000 a month. I don't remember just how many. Now, I would take what Capt. White has said from my point of view, something on my musing of last year. Personally I don't believe that we have reached a point when we can go to low candle power. In the first place, in this State we could not go below 16-candle power in any case—a few years ago we could have gone to 15-candle power; but I think we have to give everyone a light that he can use in a straight burner and one that will be satisfactory to him. If you have the higher candle power gas it is apt to be a gas of higher heat units, and, therefore, he will not use as much in his Welsbach burner, in his gas engine or in his gas stove. I personally don't believe that the day of lower candle power is with us. I would qualify that in this way: It depends upon the quality of the gas whether the candle power is high or low. If it is a mixture of water gas and coal gas I would call 25 candle power a very high candle power. So that it depends, somewhat. As to a straight coal gas, I would consider 18 candles a very good, in fact a comparatively high candle power, not exceeding 19; and in a water gas, where you don't attempt to free the gas from carbonic acid, I think that 25-candle power is about the right thing. That is my personal opinion. I know of cases in gas engines, where the very fact of being water gas, not taking the carbonic acid out, is the reason why they kept that gas in service, because the heat units were higher. Of course, we cannot go so far, that the carbonating material would be so great as to cause dirt on the valve. Returning to the question that Mr. Clark asked me to answer in the first place, given the practical question, the maximum yield of gas that will prevent practical difficulties I think is the yield that you ought to get from your gas. I don't think you ought to melt down your arches, I don't think you ought to stop up your standpipes and fill your hydraulic mains with pitch, but I would go to a point where you would just avoid all those difficulties. However, someone might fill up a standpipe with pitch because it was too small a standpipe, so the practical question comes in there, that one would have to investigate whether he has the best standpipe for the condition under which he is working.

Mr. F. C. Sherman—Not over one-third of our customers in New Haven use the incandescent light. The other two thirds would be out, if we were only making a 15 candle gas.

Mr. Walton Clark—Mr. Sherman, how much pressure do you carry on your street mains?

Mr. F. C. Sherman—The maximum is 3½ inches; the minimum is 2 inches.

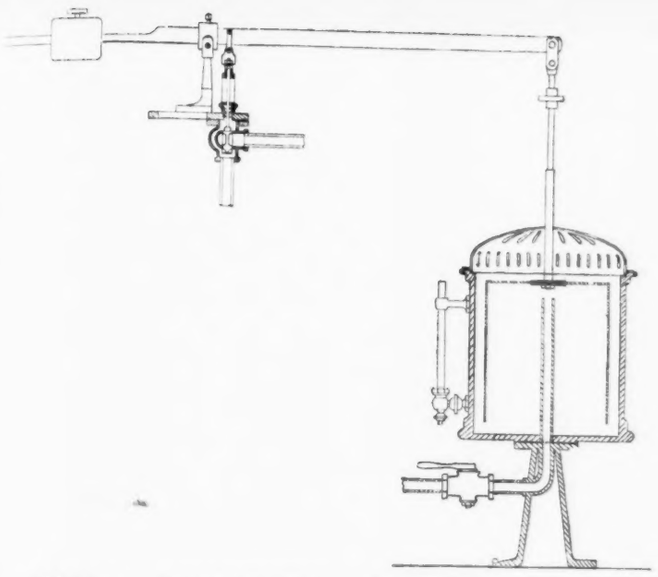
The President—Mr. Sherman, I think the Welsbach burner is the rule as far as the shops are concerned; but in the houses I don't think that follows.

The President then introduced Mr. J. J. Humphreys, Jr., of Worcester, Mass., who read the following paper on

SOME SKETCHES OF GAS GOVERNORS.

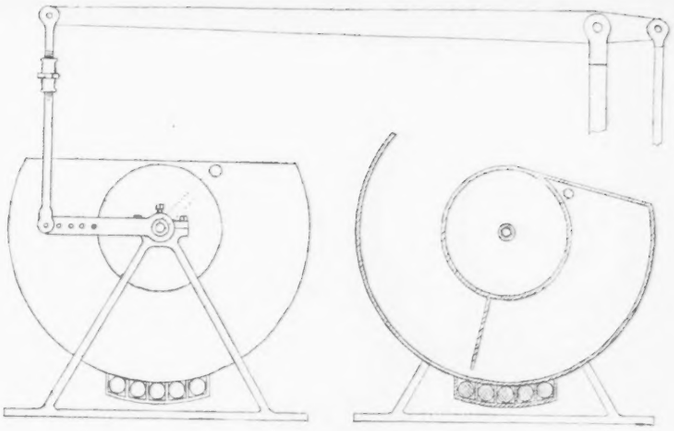
Samuel Clegg's patent of December 9th, 1815, for an "Improved gas apparatus," which was the first English patent for the wet meter (or any other), also covered a self-acting governor for regulating the discharge of gas through any opening.

The governor consisted of a short pipe, with a vertical partition, dipping into a cup of mercury. The inlet and outlet of the governor were on opposite sides of the partition, which had a hole through it, more or less closed, according to the position of the mercury cup. The mercury cup was carried on one end of a beam, which was actuated by a counter-



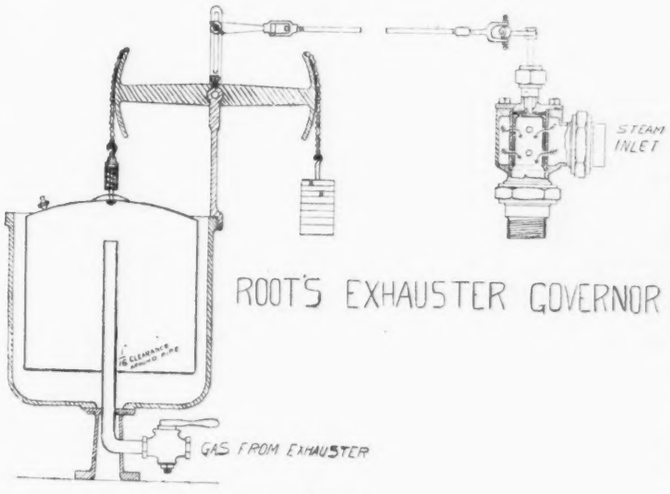
ISBELL EXHAUSTER GOVERNOR

No. 1.



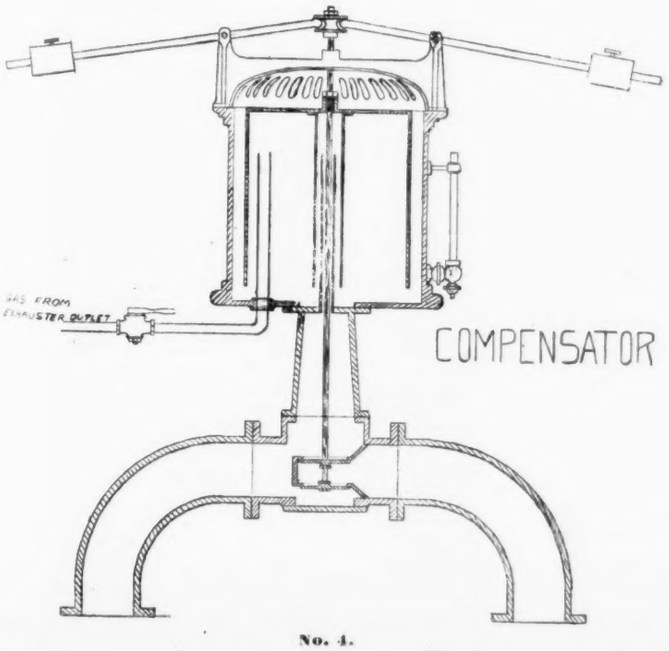
HELMES ROCKER GOV. FOR EXHAUSTERS

No. 3.



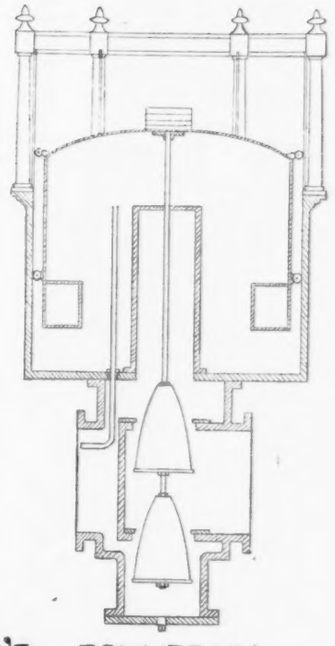
ROOT'S EXHAUSTER GOVERNOR

No. 2.



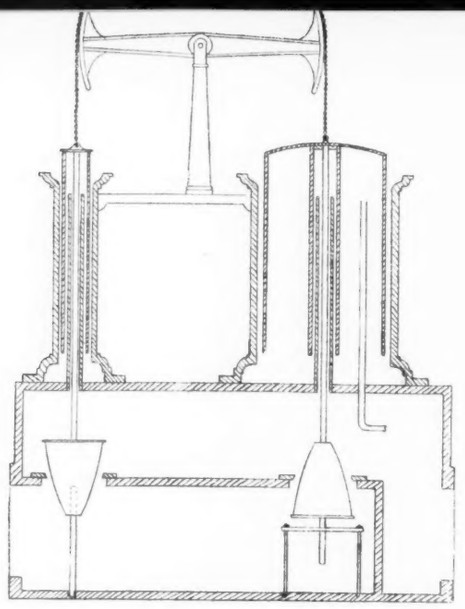
COMPENSATOR

No. 4.



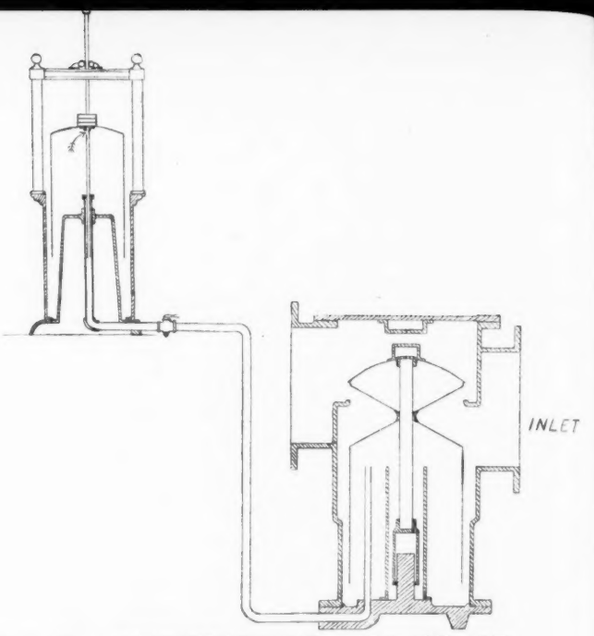
PARKINSON'S EQUILIBRIUM

No. 5.



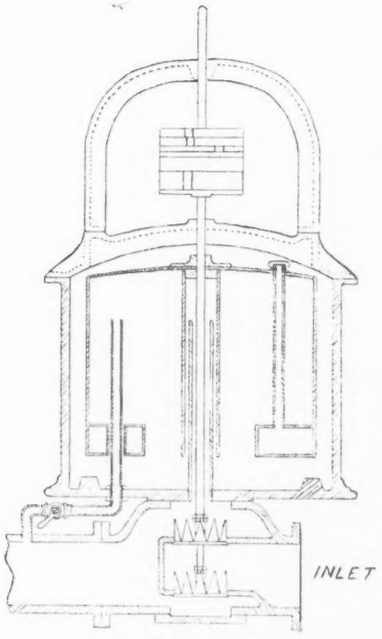
BRADDOCK STATION GOVERNOR

No. 6.



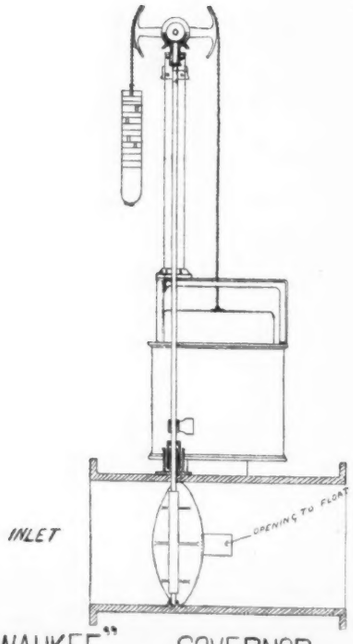
FOULIS UNDERGROUND GOVERNOR

No. 7.



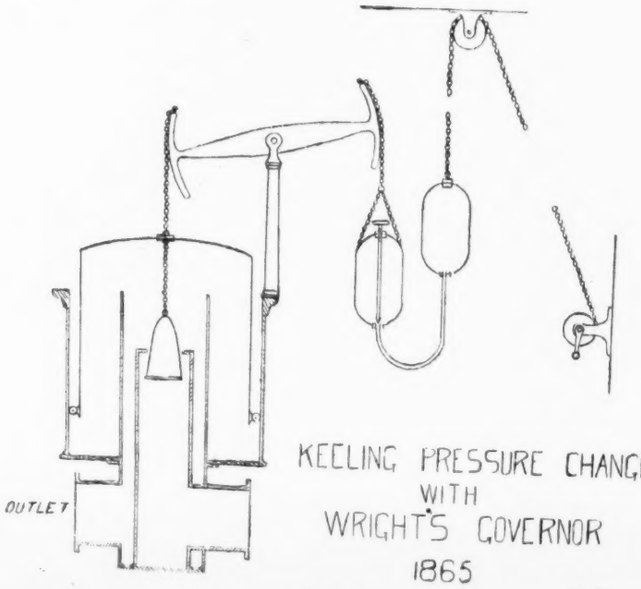
ISBELL-PORTER GOVERNOR

No. 8.



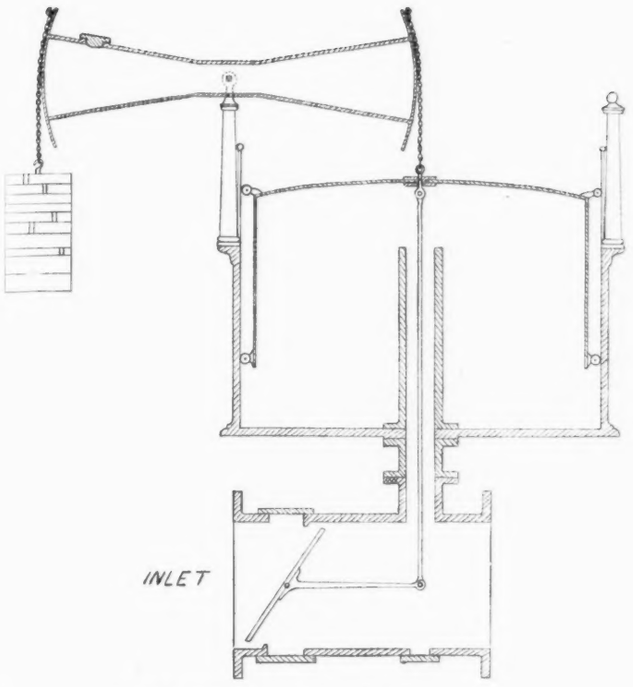
"MILWAUKEE" GOVERNOR

No. 9.



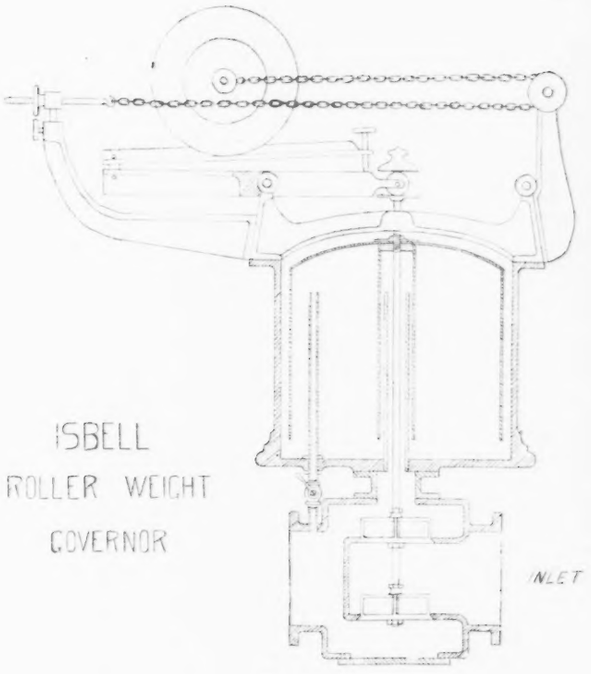
KEELING PRESSURE CHANGER
WITH
WRIGHT'S GOVERNOR
1865

No. 10.



MERCURY ARM GOVERNOR

No. 11.



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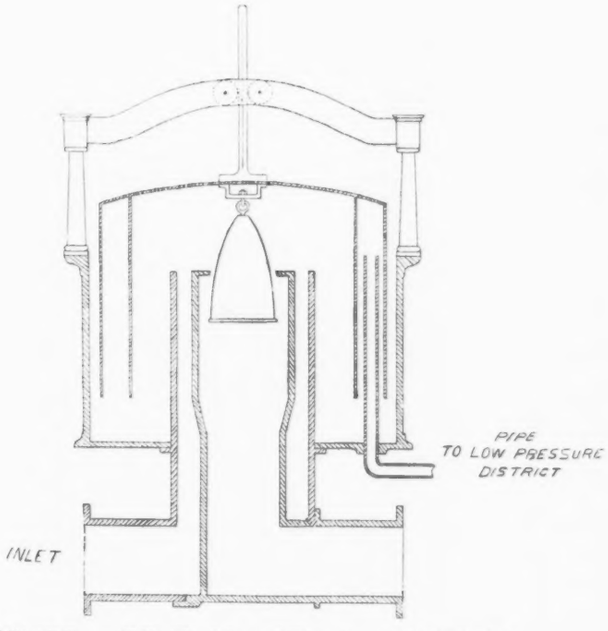

SERVIER SELF-ADJUSTING GOVERNOR

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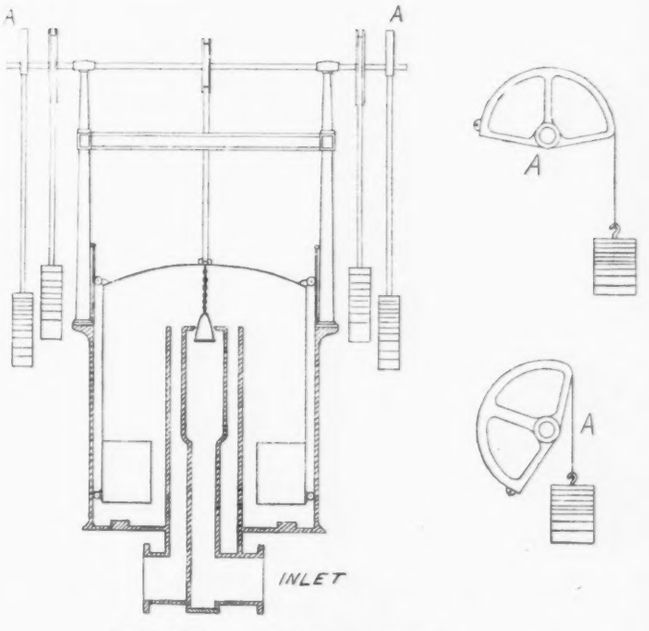
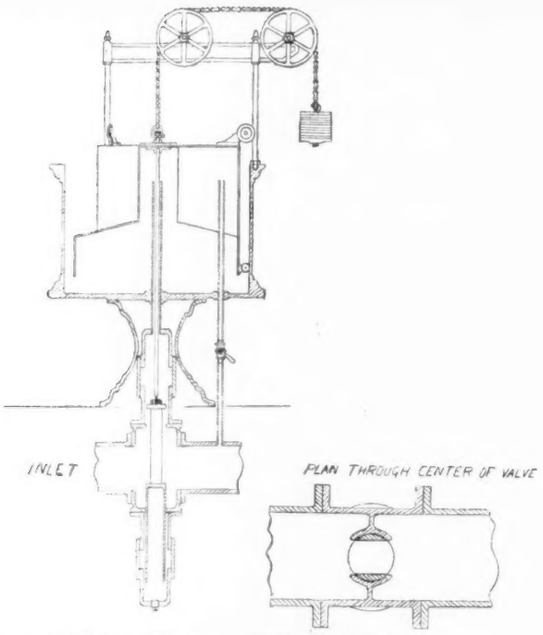


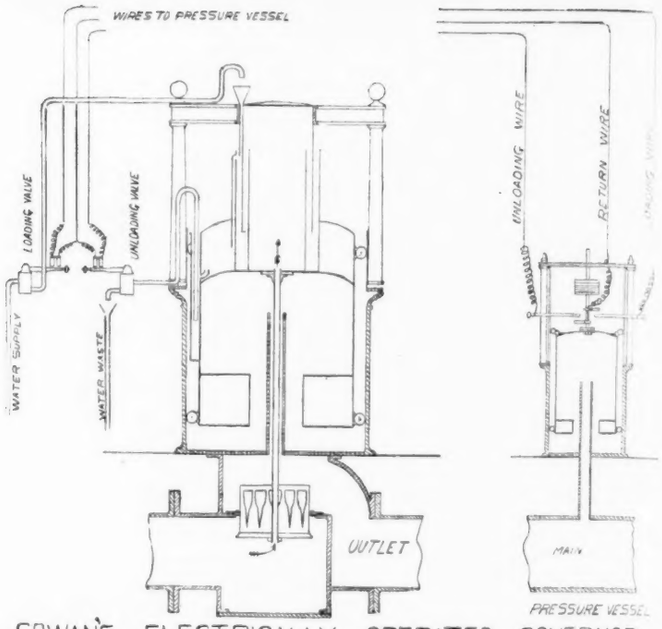
MILNE GOVERNOR

No. 14.



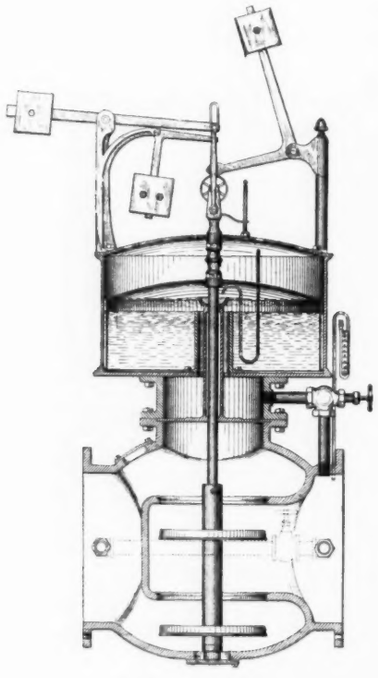
HOPPER AUTOMATIC GOVERNOR

No. 15.



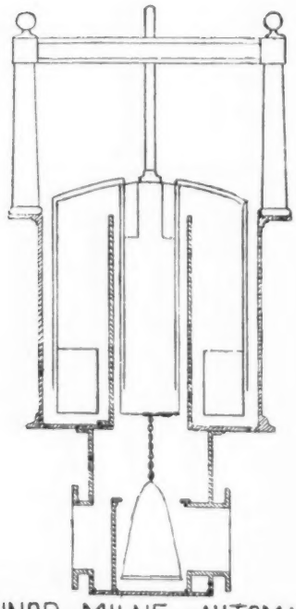
COWAN'S ELECTRICALLY OPERATED GOVERNOR

No. 17.



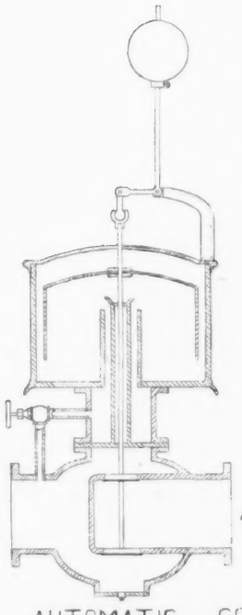
CONNELLY
AUTOMATIC GOVERNOR

No. 18.



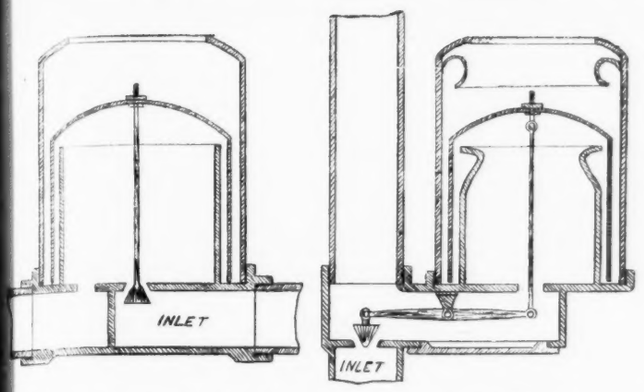
D'CONNOR-MILNE AUTOMATIC GOVERNOR
1897

No. 16.



CONNELLY AUTOMATIC GOVERNOR
1883

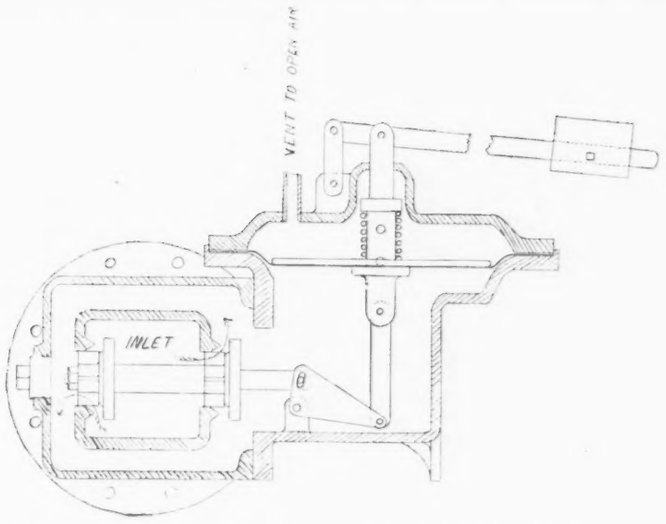
No. 19.



2 SUGG HOUSE GOVERNORS

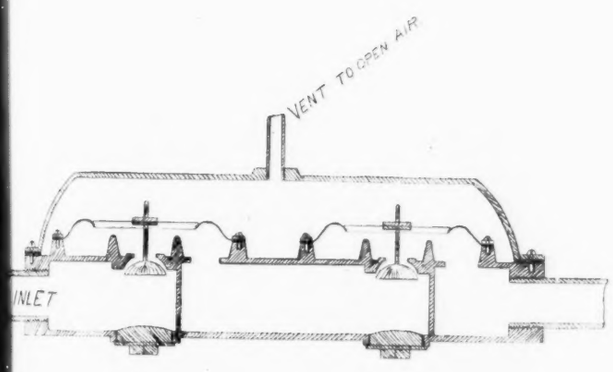
1884

No. 25.



WESTINGHOUSE HIGH PRESSURE GOV.

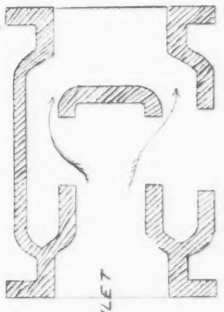
No. 29.



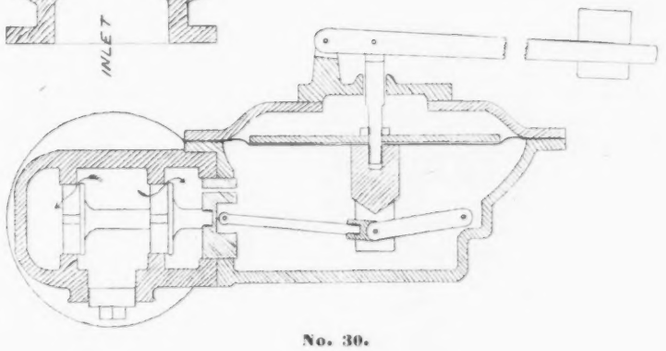
SUGG'S DRY DOUBLE GOVERNOR

1884

No. 26.



8" JOHNSON-REYNOLDS LOW PRESSURE NATURAL GAS REGULATOR



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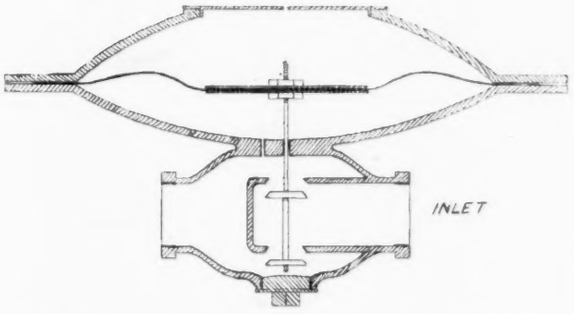
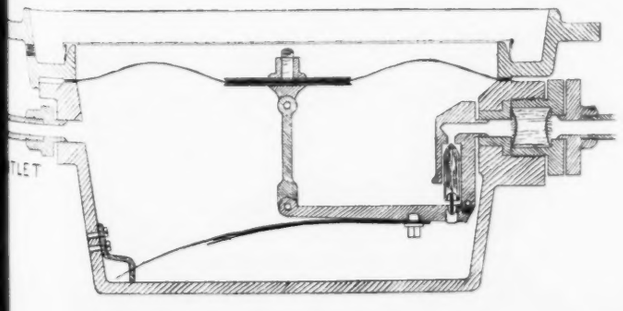


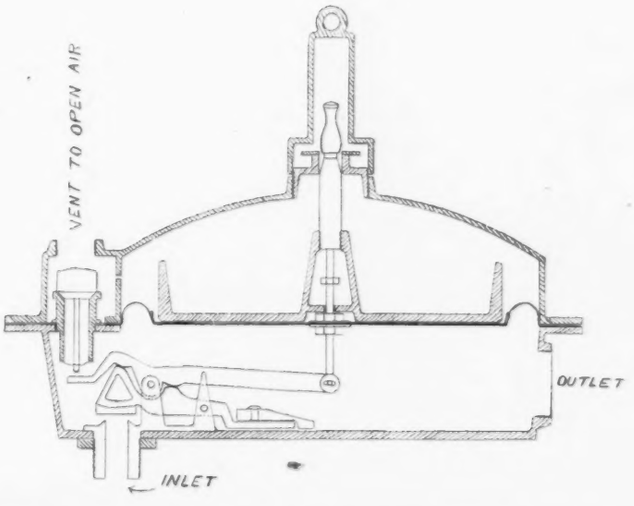
LLIAMS' BALANCED VALVE GOVERNOR

No. 27.



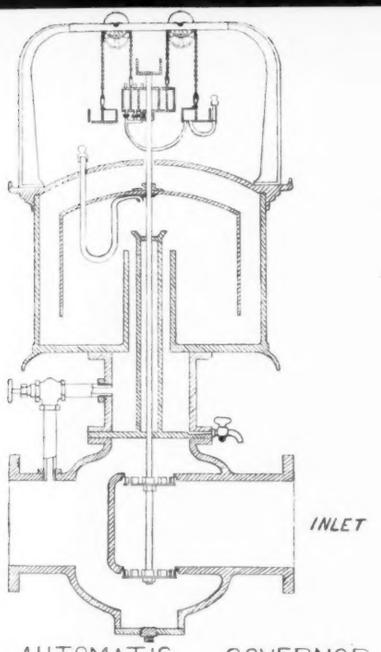
PINTSCH REGULATOR

No. 28.



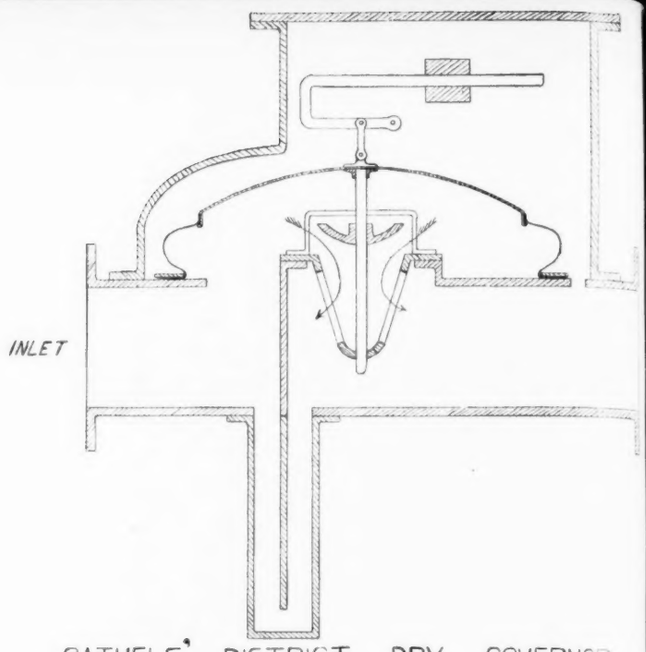
YOUNG'S NATURAL GAS REGULATOR

No. 31.



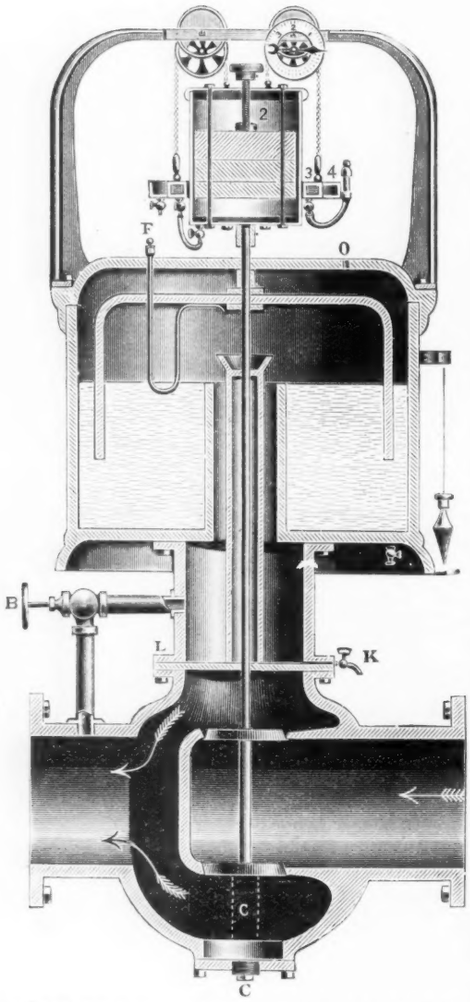
CONNELLY AUTOMATIC GOVERNOR

No. 20.



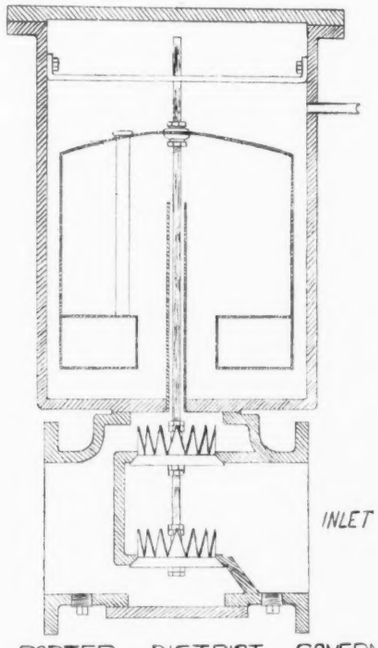
CATHELS' DISTRICT DRY GOVERNOR

No. 22.



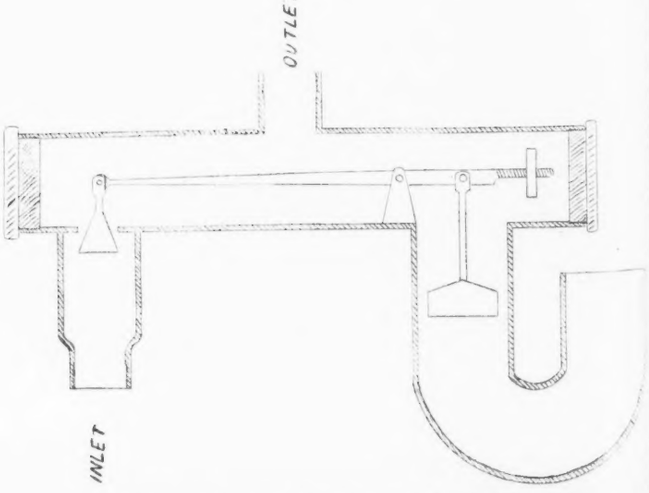
CONNELLY AUTOMATIC GOVERNOR

No. 21.



ISBELL-PORTER DISTRICT GOVERNOR

No. 23.



MERCURY SYPHON GOVERNOR

HULETT AND PADDON

No. 24.

poised, small gasometer, operated by the governor outlet pressure. This governor was said to be intended to reduce the effect of the meter pulsations.

In 1817 James West patented a governor, "Which may consist of a closed vessel, in which is placed a small gasometer, the elevation of which by pressure of gas elevates a flat circular plate or valve, and brings it more or less into contact with the mouth of the entrance gas pipe." Presumably, this is the governor mentioned in Richard's "Treatise on Coal Gas," as having been described in Accum's "Treatise," published in 1819.

The first street main governor seems to have been that of William Pontifex, the younger, which was a small gasometer, counterpoised by chains, a lever and a weight, operating a sluice or valve fitting into the main.

In 1825 Samuel Crosley patented the governor with diaphragm. The diaphragm carried a suspended plug valve.

Hugh Ford Bacon was well ahead of his time when, in 1839, he patented a diaphragm governor, with spiral spring or lever and weight adjustment and two conical valves, which are balanced by the one opening inward and the other outward.

John Parkinson claims about the same thing in his patent of December, 1853.

During the 50's and early 60's there seems to have been an awakening to the advantages of uniform pressure, and many patents were issued, of which the following were the most notable:

1853.—Moses Poole claims patent on governors set tandem.

1856.—Luther Young claims application of mercury in hollow balance lever, to change balance of governor float.

1856.—David Dick claims as governor valve a beveled or notched inlet pipe dipping into a mercury seal,

1857.—John Sudbury and Alfred Linsel claim as governor valve a diaphragm actuated piston, working in cylinder, perforated with several triangular holes.

In 1858 there were even patented as governors, fibrous masses, more or less compressed according to pressure of gas, perforated plates, cloth, and shot or seeds for checking the gas. This sounds quite like the descriptions of the governors now peddled by fakirs.

1858.—W. H. Bennett claims governor operated by small pipe from distant low pressure district, which principle was used, according to the 5th edition of "Clegg," in the Servier governor at Paris.

1859.—Rodier claims application of the increase of pressure by governor float picking up chain, each link adding to weight of float.

1861.—Henry Giraud claims pressure gauge to make electric connection at distant point, and operate by water pressure a valve at the works.

1865.—John Keeling patented his water loading pressure changer, and built a 36-inch governor on this principle for one of the London gas companies. The patent said nothing about the arrangement being automatic, claiming only that it was less abrupt than changing solid weights; but at certain adjustments it was automatic. This was the first of the water loading governors.

Richard's "Treatise," 1877, shows a governor by the Messrs. Braddock, in which the effect of the gas pressing downward on the valve is counterbalanced by the pressure of the gas from the inlet pressing upward in a chamber of the bell, which has the same area as the valve. This principle is shown also in the drawing of the Cowan governor with this paper.

Originally, the gas passing street main governors all went through the bell, but after an accident to one of the governors of a London works, various plans were devised to prevent any large amount of gas from being set free by an accident to the governor bell.

Of the compensators the earliest and simplest was the damper valve in the exhauster bye pass pipe, operating by a floating bell. The Smith and Sayre compensator, shown by a drawing, has been the one principally used in this country.

The two types of exhauster governors shown with this paper are the Isbell and the Root, the latter serving as a type of the various governors adapting the principles of the Huntoon governor.

So much can be said of the street main governors that it is best to say little. The small works using a holder throwing about 27-tenths on the town at all times has the best of governors. Next in value comes a good street main governor, which is surely better than man, who is a ways fallible. A recent article in the London *Journal of Gas Lighting*, describing the new gas works at Zurich, spoke of three governors being installed. On the main line were two governors set tandem, the first feeding to the second, or automatic governor at a constant pressure, no matter what holder was in use, or how many sections uncupped, so that the pressure at the outlet of the automatic governor would be affected only by the amount of gas passing. The third governor was on a branch pipe, and would operate to supply the town only when the other pair failed.

Care of the street governors plays a large part in their successful use. Thorough half-yearly cleanings, monthly oilings, weekly examination of water line, and daily inspection as to sticking (from naphthaline, etc.), will make any half decent street governor do its duty faithfully.

While New England has not yet reached the point of installing high pressure gas, we are all interested in it, and I have shown three types of natural gas governors and the Pintsch governor for compressed gas. I am informed that the best practice demands from 3 to 4 reductions in natural gas pressure from the well to the burner; the high pressure governor reducing from the well to the line pressure, the low pressure governor reducing to 20 or 30 pounds at the city line, the house regulator reducing to 4 ounces, and if there are any Welsbach burners used, a governor reducing to about 1 ounce. All the natural gas governors looked up, except those for the illuminating line, have safety valves, blowing off into the open air in case of trouble, and most of the governors are to be had with either spring or weight and lever adjustment. All the house regulators had automatic valves, which closed in case of failure of supply, and would not again pass gas until started by hand.

No. 1.—*The Isbell Exhauster Governor.*—A small float and weighted lever operates a balanced piston valve, supplying exhauster engine with steam. Exhauster pulsations in float reduced by throttling gas supply of float.

No. 2.—*Root's Improved Gas Exhauster Governor.*—A refined Huntoon with a very similar steam valve placed vertically. The float has a bottom with only $\frac{1}{8}$-inch clearance all around the inlet pipe for the water to work through. This aids in reducing the exhauster pulsations in bell, which are also guarded against by the spring connection, and by throttling the gas supply to float.

No. 3.—*The Helme "Rocker" Exhauster Governor.*—The gas from outlet of the exhauster enters the closed side of tank, increasing or decreasing the space above water line, and thus turning the tank and operating the steam valve on exhauster engine. The flow of water is retarded by the diaphragm plate at the bottom.

No. 4.—*Isbell-Porter Compensator.*—A simple balanced valve governor on exhauster bye pass, opening to pass part of the gas back when there is too much pull on the inlet side of exhauster.

No. 5.—*Parkinson's Equilibrium Governor.*—The large float with small gas passage to it and simple balanced valve, make the governor very steady in its action.

No. 6.—*Braddock's Balance Governor.*—This governor is also made with automatic water loading attachment, in which a tank on top of the governor float connects by a rubber tube with a tank carried by another float, the raising or lowering of which by the outlet pressure of the governor loads or unloads the governor float. The tank on the loading float maintains its water level by a ball-cock and an overflow.

No. 7.—*The Foulis Underground Gas Governor.*—In this governor the float is also the valve, and is operated from the separate pressure vessel placed not more than ½ half mile away. Loading the pressure vessel increases the pressure under the governor float, with which it is connected by an air pipe. The governor is steadied in its action by the plunger, which works on the anti door-slammer principle. The plunger and portions of the float (not shown in drawing), across the valve opening, act as guides.

No. 8.—*Isbell-Porter Standard Street Main Governor.*—The weight of valve and float is supported by a submerged air chamber, which can be loaded with water to give the minimum pressure, the weights being used only for increase of pressure. The upright edges of the balanced valve are notched to make the governor sensitive. These valve edges and the arbor on top of governor act as guides for the valve stem.

No. 9.—*The "Milwaukee" Damper Gas Governor.*—This governor has a vertical damper, operated by gearing from the balance arm supporting the float. This governor is in use at Milwaukee and at Racine.

No. 10.—*Keeling's Pressure Changer on Wright's Governor.*—The outer water tank can be raised by hand windlass to discharge into loading tank, or can be set at such position that the movement of the balance arm will do the loading or unloading.

No. 11.—*Mercury Arm Governor.*—The hollow arm contains mercury, which flows to the inner end to increase the pressure when the float has lowered sufficiently, the action being reversed when the float rises.

No. 12.—*Isbell's Roller Weight Governor.*—The pressure was changed by the rolling in or out of the weight, according to the inclination of the tracks.

No. 13.—*The Servier Governor.*—The float was acted on by the outlet pressure at the governor, and also through a small pipe by the pressure in the low pressure district.

No. 14.—*The Milne Governor.*—A weight suspended from a helix puts more or less weight on the bell as it rises or falls, according to the varying distances of the suspended weight from the center of shaft.

No. 15.—*The Hopper Automatic Governor.*—As the float sinks with the opening of the valve, the area of float at the water line decreases, thus throwing a higher pressure.

No. 16.—*The O'Connor-Milne Governor.*—As the bell sinks, two siphons transfer water from the tank in which the bell floats to a water tank carried in the center of the bell, increasing the pressure.

No. 17.—*Cowan's Electrically Operated Governor.*—A small pressure vessel in the distant low pressure district makes connection with the loading or unloading wire as the pressure rises or falls. The weak line current operates a relay at the governor station, which allows a stronger current to pass through the magnet, opening the loading or unloading valve. To avoid variable or excessive water pressure, the water for loading is taken from a tank giving about 10 feet head. The tank is supplied by a ball cock. The pressure on the governor gas valve is balanced by the downward pressure in a compartment of the same area as the valve.

No. 18.—*Connelly Automatic Governor*, 1883 (?).—This apparently is the first Connelly governor in process of evolution.

No. 19.—*Connelly Automatic Governor.*—As advertised for sale in 1883.

No. 20.—*Connelly Automatic Governor*, 1884 1899.—As the float descends, mercury flows from the outer vessel to the mercury vessel on valve stem, increasing the pressure. By varying the combination of compartments into which the mercury flows, and by opening or closing ports in the vertical sides of the valve, the governor can be adjusted as to the length of stroke that will give maximum pressure, and as to length of stroke that will start to put the pressure on.

No. 21.—*Connelly Automatic Governor*, 1900.—The central mercury vessel in this model is made of glass, and has a displacement block with screw adjustment, so that mercury can be made to rise to any height, thus adjusting the length of stroke required to put on maximum pressure. The same governor without mercury vessel is used as a simple balance governor.

No. 22.—*Cathel's District Dry Governor.*—This governor reversed the usual operation of governors, and instead of maintaining a constant outlet pressure, it maintained a constant difference in pressure between inlet and outlet.

No. 23.—*Isbell-Porter District Governor.*—Similar to the Isbell-Porter Standard Governor, but with a closed top and small pipe to atmosphere.

No. 24.—*Hulett and Paddon's Siphon Governor.*—The inverted siphon holds mercury, on which the float rests. Changes in level of mercury correct the pressure.

No. 25.—*Sugg Governors.*—The tanks on these governors were so shaped that should the seal blow, the liquid would drop back into its place, instead of leaving the tank.

No. 26.—*Sugg Tandem Dry Governor.*—The dry governor so often seen on old bar photometers.

No 27.—*Williams' Balanced Valve Governor.*—A simple and accurate balanced valve, mill or house governor. Will handle fairly high pressure. The top is tight fitting, except for a small "breathing hole," so that little gas could escape should the diaphragm dry out and break.

No. 28.—*Pintsch Compressed Gas Governor.*—The governor will control 1,500 pounds inlet pressure, absolutely sealing the inlet, with a scarcely noticeable rise in outlet pressure. The adjustment of the outlet pressure is by tension of the spring. The perforated cylinder at inlet end is to contain a strainer to keep pipe scale and dirt from the valve.

No. 29.—*Westinghouse High Pressure Natural Gas Governor.*—Tested in 300 pounds pressure, but will take the highest known well pressure and reduce to outlet pressure of from 5 to 50 pounds. The diaphragm plate and spring act as safety valve in case of dirt or scale under controlling valve.

No. 30.—*Johnson Reynolds Low Pressure Regulator.*—This governor reduces an inlet pressure of 30 to 50 pounds, down to an outlet pressure of from 2 ounces to 5 pounds. The drawing does not show safety valve.

No. 31.—*Young's Fuel Regulator.*—With automatic cut off and dead weight safety valve for natural gas. In case of accident to diaphragm, or stoppage of supply, the diaphragm plate drops, closing off the supply and raising safety valve. No gas can pass again until the plate is raised by hand.

Discussion.

The President—I think you will agree with me that this will become the classic for information on governors; for not only has Mr. Humphreys spent a great deal of time personally in making those sketches, but he also has been thoughtful enough to spend a great deal of money as well in this edition of his paper.

Capt. McKay—I would like to express the great satisfaction one has in a paper of this sort, prepared with such care and so copiously illustrated with these very carefully drawn diagrams. I think it is something which serves, by referring to the lines along which advancement has been possible in the past, to point to the lines in which development will be probable in the immediate present. I would also like to hear from Mr. Shelton concerning the regulators which he has actually used on those lines in which he distributes gas under high pressure.

Mr. Shelton—Capt. McKay's question brings out a comment that I think it only fair should be made on Mr. Humphrey's paper. I very much appreciate the work put into the collection of these illustrations of past and present forms of governors. Having been through more or less of that work myself, I think it is very valuable and something that ought to be encouraged—viz.: The getting on record in our Association proceedings of thoroughly complete "round ups" of the various forms of our standard apparatus. It has only been done, I think, in two or three directions, and if it were done more generally and more systematically the collected information would be of very great value to those who are looking up such subjects in the future. At the same time such information, to be of the fullest value, necessarily must be complete, and unless a thing is given as complete, and vouched for as a *complete* round up of the various forms, it is very apt to be deceptive and misleading to some one who might make use of it, thinking that all the forms or all the facts were there, and not finding some quite important forms of apparatus that for one reason or another had not been covered. There are a few forms of governors which are not covered in the list that Mr. Humphreys has presented, and, therefore, I simply want to make a statement of fact, so the record may show that, while it is a very good collection of typical and representative forms of such apparatus, it is not necessary (nor do I think it is so offered) as an absolutely complete record. Hence any one using it to look up in the future should supplement it by such other information as may be necessary. I say that because, in using artificial gas at such high pressures as 5, 10, 15 or 25 pounds, as I have been doing in the last year in several instances (and universally with entire satisfaction as to results), I have used some governors which were not shown by Mr. Humphreys nor to which any reference was made. He illustrates one type of such as I have used, and I have used that type, but in another form. He also does not, very naturally, show the forms of governors for controlling high pressure natural gas lines, which are different from the house, district and small, low pressure governors shown, but which are going to be used in the artificial business if high pressure is used to any extent. I merely want to bring out the point that so many different forms are used that one must be very careful not to take any statements as complete without having fully looked up the records. Answering Capt. McKay's questions more directly, as to the efficiency, as I understood it, of the governors of the forms that I have been using, I will say he would be entirely satisfied with some of the little cast iron governors working on the diaphragm principle, of the Pintsch type or of the Johnson-Reynolds type, to which Mr. Humphreys has referred. They seem to do to their work substantially perfect. Out of every hundred one or two may be defective—the diaphragm may have a little flaw in it. We make a practice of inspecting those before we put them

up; but, generally speaking, we have no more trouble than in putting out the same number of ordinary gas meters. We have no more complaints and we have no more looking after such apparatus to do. As far as the governors are concerned, I think they have been wonderfully well worked out for the particular work that is to be done. For instance, the Pintsch governor, as we know, is a marvelously perfect piece of mechanism. It controls practically any pressure on the high side down to any desired pressure on the low side, at one jump and under any conditions. With variation of temperature, the non-attention and the various factors that go against the satisfactory working of such mechanisms, the Pintsch governor, I believe, is yet a practically perfect machine. Other governors of similar type are perfect for their particular work. One has to exercise, however, a good deal of care to pick out the right governor for the class of work to be done. For instance, the natural gas governors—that is, "low pressure" governors in the houses—are used to handle a good deal of *volume* of flow for natural gas in ranges, etc., at comparatively moderate *pressure*, say 10 ounces or a pound or 2 pounds or 5 pounds, permitted in the city. The Pintsch governors, on the other hand, are designed to handle very *minute quantities* of gas at very *high* pressures, 200 and 300 pounds. The governors that I have had occasion to use have little different factors to contend with and different conditions to fit. They require to handle less gas than the natural gas governors, as a rule, more than the Pintsch governors, at less pressure than the Pintsch governors work at, but at more pressure than the low pressure natural gas governors work at, and that affects the areas of the diaphragms, the length of the levers, the areas of the passageways, etc. Hence, in using governors for any particular service great care has to be observed that the governor is adapted to the work that is to be done. I believe a governor can be made for any work desired. On the high pressure work with which I have been connected generally speaking we have had no trouble of any moment from governors of any description.

The President—In order to make this complete would you object to sending to the Secretary some additional cuts of governors, if you have them, so that we could make the illustrations part of your discussion.

Mr. Shelton—I should be very happy to.

Mr. F. C. Sherman—I would like to ask Mr. Humphreys if, while looking up this question of governors, he found a description of what is called Hunt's equilibrium governor. I ask that question from the fact that 25 years ago I copied a drawing or a cut of one as shown in the AMERICAN GAS LIGHT JOURNAL and tried it in at the Worcester (Mass.) gas works, and it was a success. Since then I have removed the governors which I found in use at New Haven, Conn., and put in their place this Hunt's equilibrium governor. They were made in Worcester at the time I was there. One was sold to the Springfield (Mass.) Gas Company and another to the Holyoke Gas Company. As far as I know they give satisfaction. I speak of them because the cost is merely nominal, in fact very slight as compared with what you have to pay for other governors.

Mr. J. J. Humphreys, Jr.—As my drawing was done at night and as I needed some sleep, I named the paper "Some Sketches of Gas Governors." I made no pretence of covering the ground thoroughly. As an actual fact I searched out something like 60 or 70 and only had time to draw 30. I had inklings of where I could find about 30 or 40 others, so I thought I had better stop. The Hunt governor was left out for that reason. Of the natural gas governors of which Mr. Shelton speaks I have only drawn three, although I found very many of them—all of those mentioned in Mr. Shelton's paper at the Paris Exposition, of course—and he probably knows many more, and then a great many from the makers of the natural gas governors, which I did not put in.

The President—Mr. Shelton, I did not know that in your paper at the Paris Exposition the high pressure governors were illustrated. If so, as the paper is mentioned in the Humphreys' paper, perhaps those cuts could be added.

Capt. McKay—Will Mr. Shelton state the pressures on either side of the governors which he has in use on these high pressure mains—that is, the reduction of pressure which is effected?

Mr. Shelton—Readily. The first one I believe we worked at a range of from 20 to 30 pounds pressure. In that case we wanted to convert that varying pressure on the high side into the low pressure mains, bringing it down to about 2 or 2½ ordinary pressure. We concluded that the governing would be rather more delicate if we used two governors tandem. We simply used the mechanism that our natural gas friends had worked out, rather than try to evolve something ourselves for which there was no need. We used a natural gas governor warranted to cut from 50 pounds to 5 pounds at one clip, and following that a second governor to cut the gas from 5 pounds to a couple of inches pressure. We found, as a matter of fact after connecting them up, that one governor was not in balance and the other one was doing all the work. We put those in at the first because it was desired to be on the safe side and have the utmost possible delicacy of control, and two governors taking succesive steps seemed to us a little bit safer. Upon looking into the matter, however, as time went on, and we had more chance to investigate what was done, we came across other governors which do the work at one clip. We have governors in use on another pipe line, jumping from 40 pounds on the high side to 40 tenths, or 20 tenths (26 tenths, I believe they are set for), on the low side. They hold that pressure within one or two tenths right along on 24 hours' run. They are practically Pintsch governors in that way, you see, as far as the work done is concerned—the high pressure on one side is many pounds, ranging 5, 10, 20, 30, 40 or whatever we may happen to be running. When we make additions to the high pressure pipe system we run the pressure up for the purpose of testing the pipe beyond the pressure that we carry for ordinary working, which is perhaps 10 or 20 pounds. We have a number of house governors all along the line of 2 or 3 high pressure pipe lines, and those little house governors, that look like cast iron pots with a diaphragm inside, costing $3 or $4, and set in advance of the meter, convert the pressure from 5, 10, 15, 20 pounds, whatever the pressure may be on the high side, to 17-tenths water on the low side, which is about what we set for in house private services. Those governors are protected by a device by which, if they should fail to work (and such a thing very rarely happens) the gas cannot get into the consumer's cellar or into the meter, and are further protected, so that if both the governor and the protector should fail to work, no more gas can get into the premises than would come in under ordinary low pressure on the ordinary inch service. We believe we have our protection absolutely complete and not dependent on mechanism as against the safety of the customer. The devices cut from 20 pounds or any varying pressure on the high side to whatever we set them for on the low side, and they only vary a tenth or two, sometimes not that.

Capt. McKay—I understood Mr. Shelton to say that these governors were set on the inlet of the consumer's meter?

Mr. Shelton—I mean between the stone wall of the cellar and the inlet of the meter; in advance of the meter.

Mr. Coggeshall—On page 14 Mr. Humphreys probably shows what is really known as the Kidder governor. It is only one part of it. There are two sections. What is here shown sets on the floor, and this sets on another holder below the floor, which regulates the valve in the pipe. There are two holders to it. Otherwise it is all right. I have used it for 20 years, and it is perfect, automatically shutting out the gas, commencing to shut off about 11 o'clock to 1.6 inches, opening as the demand may be the next day.

Mr. W. A. Learned—I think Mr. Humphreys spoke rather disparagingly of a district governor. We have had three district governors of the type shown on page 26—Isbell Porter district governor—in use for 3 or 4 years. We use in it for a liquid water and glycerine. It is in a manhole thoroughly sealed with a type of cover that the telephone people use. It works very nicely. There is a governor that is equally as good (the Connelly) without the automatic attachment, that could be used for a district governor.

Mr. J. J. Humphreys, Jr.—I did not know that I spoke disparagingly of district governors. I don't see anything here indicating that I did, and I did not mean to.

On motion of Mr. W. A. Learned, a cordial vote of thanks was passed to Mr. Humphreys for his paper.

The President—It is after the time of adjournment. I want to call your particular attention to the fact that two important papers for the morning are on our list: "How They Do Things on the Other Side," by Mr. F. H. Shelton; and on "Selling Gas," by Mr. C. J. R. Humphreys. Hence I trust you will come together promptly to-morrow at 10 o'clock. In addition to those mentioned we are to have a few words on "Inclined Retorts." I don't know to what extent his paper will be, but Dr. Schniewind will be here, and I am anxious to have this paper of Dr. Schniewind's read at the meeting rather than out at the coke works. You are all invited to go to the coke works to-morrow afternoon. I don't know definitely the hour. If the worst comes to worst so far as getting through, why, he will have to read that paper, probably at the works, but I trust it will be read here, so that we can get the discussion we ought to have and then take your entire time in looking at the works. We have not yet heard from the Nominating Committee. You will listen to the

REPORT OF THE NOMINATING COMMITTEE.

Mr. Charles F. Prichard, from the Nominating Committee, reported the following list of office bearers for the ensuing year :

President—Mr. Waldo A. Learned.
Vice Presidents—Messrs. William E. McKay and Frank S. Richardson.
Secretary and Treasurer—Mr. N. W. Gifford.
Directors—Messrs. Walter G. Africa, William McGregor, William H. Snow, Joseph E. Nute and B. J. Allen.

ELECTION OF OFFICERS.

On motion of Capt. White, the Secretary was instructed to cast the ballot of the Association in favor of the election to office of the gentlemen named by the Committee on Nominations. The Secretary having announced the result of the ballot, and the President having declared the nominees duly elected, the President elect was escorted to the Chair by Capt. McKay, to an accompaniment of cheering. When the cheering had ceased, President-elect Learned, said :

Gentlemen of the Association, I thank you for the honor conferred upon me. I realize full well the responsibilities of the office to which you have promoted me. My best hope is that our next meeting will be as successful as the present one, and I know that it will be with your co-operation. (Applause.)

The President, in resuming the Chair, announced that the time for adjournment had arrived, and a motion to that effect was carried.

[To be Continued.]

Improvement in Orsat Apparatus.

By MR. A. BEMENT, *in Jour. Am. Chem. Soc.*

Having experienced considerable trouble in using the Orsat gas apparatus, I have devised a modification with the object of removing what I have found to be a serious and troublesome fault.

Fig. 1 will illustrate the particular difficulty in question. It is that

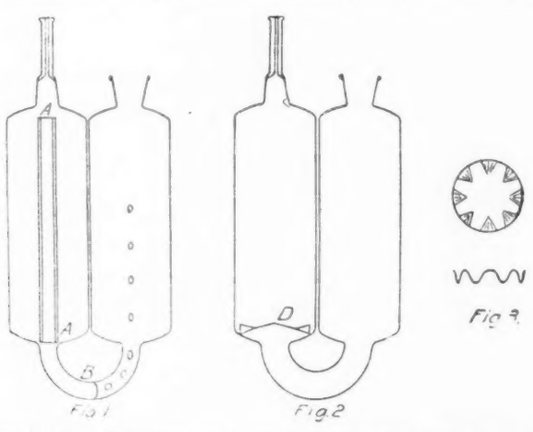


Fig. 1 Fig. 2 Fig. 3

of the usual form of pipette used especially for the caustic and pyrogallate reagents, having a number of small glass tubes inclosed in the front leg. For purpose of illustration only one of these tubes is shown by *A.A.* As this chamber in practice is full of these tubes, it necessarily follows that one of them must be in the center, and this one may, and often does, drop down in the position indicated in the sketch. The result is that a direct passage from *A* down through the tube and into the branch *B* is produced, and at the same time, the outlet from the other tubes and the remainder of the chamber is stopped off, leaving the outlet for the reagent only by way of this center tube, because by its junction at lower *A*, a close connection is made. The result is, that as gas enters the pipette the reagent instead of uniformly receding before it is driven down the center tube, and this condition may exist to such an extent that the reagent is driven to the point *B*, when the gas, owing to its lower gravity, will bubble up through the reagent, as shown, and escape to the atmosphere.

It does not always follow that this center tube will make as close a junction as shown, but the trouble exists to a greater or less degree in all instruments. I have found cases where it required a period of 15 minutes to pass the gas sample into the pipette, and have known of frequent errors caused by a loss of gas from this cause. It is, of course, true that if sufficient time be taken, the gas may be worked into the pipette without loss, but it is certainly desirable and important that the analysis be effected with as little trouble as possible, and in the shortest time consistent with careful work. It may be observed when gas is passed into the pipette that the reagent does not recede equally before it, but that contained in the center tube may drop down lower than the surface in the other tubes. Likewise, when the gas is withdrawn the reagent returns in greater volume by way of the center tube, and will rise higher and run over the top.

To overcome this difficulty, I have devised the pipette shown in Fig. 2, which prevents the tubes dropping down into the outlet by interposing a glass disk with corrugated edge, as shown in Fig. 3. This not only affords a support but allows a free passage of larger area from each tube to the connecting branch, as the depressed edges of the disk rest on the bottom of the pipette chamber, leaving ample passage between the corrugations. The connecting passage may also be made larger, thereby affording opportunity for the quick passage of the reagent, and shortening the time required for absorption.

Shop Organization and Bookkeeping.

Iron Age in discussing these matters says : A well informed and incisive writer in one of the English reviews, in a discussion of the present condition of British industry, makes a point which is worthy of thoughtful consideration by manufacturers on both sides of the Atlantic. It is that of late there has been a tendency to neglect the requirements of the shop, in the matter of thorough organization, to indulge the fad of over organization in the office and counting room.

Those who have had experience in manufacturing in a large way will understand without difficulty how nearly irresistible is the temptation to concentrate the attention upon the exigent problems of the daily correspondence, as of more immediate interest than those of the mill and factory. It is natural enough to postpone for the "more convenient season" which never comes the close and critical study of methods and processes which invite attention less because of known than of suspected deficiencies in organization and management. The tendency to become more and more a merchant and less and less a manufacturer grows upon a man with increasing years; and until it shall be found that good bookkeeping compensates for lack of vigilance in maintaining the productive end of a business at the highest attainable standards of economy and efficiency it will be quite possible to invite disaster by too much concentration upon the office and too little upon the shop. We have known a number of instances in which manufacturers have been so enamored of the science of accounts, and have spent so much time and money in trying to find out what their goods cost them, that their trade has slipped away from them, their shop costs increased beyond the point of possible profit, and the net result, after years of struggle, a bad failure and an unsatisfactory settlement with creditors.

One of the most profound students of accounts we ever knew—a manufacturer of long experience—thought he had solved the problem of shop costs so perfectly that he could give all other manufacturers in his line instruction in bookkeeping and profit getting ; but about the time he was ready to retire he made the uncomfortable discovery that his business was chiefly in his books and that his plant had ceased to be profitably productive. His assets were probably not worth 10 cents on the dollar of his inventory valuation, and his liquidation left him bankrupt.

Accounts are extremely useful ; indeed, modern business would be almost impossible without them ; but too much dependence can be placed on the showing of books, and the more intricate the system of accounts the more likely is it to conceal the essential facts of profit and loss. It is safe to say that the wisest employment of a manufacturer's time and thought is in perfecting his plant, his shop methods, his industrial organization and his product. To make any of these secondary to a system of bookkeeping which tries to keep track of every nail and every bit of string is unwise. It may be a satisfaction, when one makes an assignment, to know why the business was unsuccessful ; but it is vastly more satistactory to know that it is successful and profitable, and the steps by which these desirable ends are attained are more often taken in the workshop than in the counting room.

As the rule those who most exaggerate the value of bookkeeping refinements, and attach most importance to methods of accounting which are supposed to be infallible, suffer from the disadvantage of using lenses of too high power and too narrow a field. In such matters the telescope is sometimes of more value than the microscope, and it often pays better to learn what others are doing than to know with unnecessary particularity of detail what one is doing oneself.

A conspicuously successful manufacturer, who for many years had occupied a prominent place in the public attention as a masterful organizer and a phenomenal money maker, was one day visited by a committee of the directors of a company in the same line of business. They

said to him that it was the desire of their board to improve their office methods. The ways and means of doing so had been discussed without conclusion, and it was decided to ask their most successful friendly competitor if he would permit them to examine into his system of counting room organization, with a view to the adoption by them of such features as promised advantage. He assented promptly and cordially, but assured them in advance that it was a waste of time and trouble, since they would not follow his methods if they knew them. Their first visit was to an office in which 4 or 5 men were at work. "This," said the guide, "is the key to my business success. Unless this interests you the details of my counting room organization certainly would not. This office costs me $80,000 a year. It has no direct connection with the productive end of my business, and in a sense it may be said that it does not earn a dollar. Its object is to find out for me everything which can be learned which it is useful for me to know. Through it I am advised daily of every important event touching this business in every part of the world, and I know probably better what everything my competitors make costs them than they do. If I find that anything I make costs too much, and that I am not ahead of the race, I know just where to put my finger on a weak spot in my business and lose no time in doing so. This is the focal point in my organization. Without it I might have to visit you to ask for advice. The man sitting at the desk in the corner is paid a salary 50 per cent. higher than your general manager gets, and he earns it; but I know your board well enough to be quite sure that they would not pay 10 per cent. of the cost of this one room for anything so intangible as information." The committee, like the young man in the sacred parable, went away sorrowful. It might not have paid them to imitate the system of which they had had a glimpse; probably it would not. The value of information depends a good deal upon the ability of the recipient to assimilate and utilize it.

The success of a business is recorded but not made in its journal and ledger, and no manipulation of the trial balance will shift a dollar from the debit to the credit side of a year's record. This does not mean that accounts are in any sense negligible, or that the manufacturer can afford to be content with haphazard methods of bookkeeping. It may, however, suggest that too much introspection and too close concentration upon one end of a business does not make for success, and that, however useful an analysis of costs may be, it needs, like any other analysis, to be interpreted in the light of a broader knowledge than can be gained in the retort or at the bottom of the crucible.

Cost of Electric Current in Massachusetts.

The Board of Gas and Electric Light Commissioners of Massachusetts have submitted to the House a communication in response to the order which was passed by that body recently. The order asked the Commissioners to state the cost of manufacturing and distributing electric light, and what, in their opinion, is a fair and reasonable price for consumers to pay for the same. In answering they say the order as passed presents peculiar difficulties in the way of a clear and specific reply. "As we understand it, it is general in character and does not apply to any particular company or locality, and requires a statement of the cost per kilowatt hour, the unit in common use. There is necessarily a considerable variation in the different companies under different conditions, in the class of both manufacture and distribution, and there is no standard of cost in either of these departments which is applicable to companies generally.

"The cost of generating varies materially according to whether water power or steam power is used. If the latter, the pipe or steam plant in use, the cost of fuel and ample water supply, the relation of the ordinary to the maximum demand and the conservative steadiness of the daily station road, are important factors affecting the generating cost. Using the term distribution in its strictest sense, the variable factor of most importance affecting the cost is probably the relation of the volume of business to the area in which the electricity is supplied. If the term distribution be used in the wider sense to include all the cost outside of the station, such as management and taxes, the volume of business and the value of the plant and the relation of these two to each other are important in determining the cost per unit. When the fair and reasonable price to the consumer is to be determined, not only these variables to the cost of production and distribution are to be considered, but the necessary charges for such depreciation as may not be provided otherwise together with interest or dividends upon the investment.

"The last named is frequently of more importance than any of the others and may vary more than the others according to the relation of the volume of business to the investment. From data in the annual returns it appears that the cost at the station or cost of manufacturing varied during the year, ended June 30, 1900, in different companies from less than 2 to more than 7 cents per kilowatt hour; the cost of distribution, including management, from 1 to nearly 6 cents, while the dividend cost varied more widely.

"These facts indicate the difficulty of applying to companies generally any definite statement of costs and the necessity for a careful analysis of local conditions before attempting to determine the fair and reasonable cost per unit of these items in any particular company. These suggestions, we trust, explain our inability to reply to the inquiry as specifically as we would wish and as may have been expected when the order was passed."

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

A. W. SAVIN is informed that an amendment to the charter of the Petersburg (Va.) Gas Light Company was granted by the Hustings Court on February 21st, 1901. Under the amendment the Company was granted the power to sell to any other Company, or individuals, provided the approval of three-fourths of the shares was obtained.

ADVICES by way of Newark, N. J., dated some days ago, are to the effect that the United Electric Company, of New Jersey, has made a bid for the properties of the Morristown (N. J.) Gas Light Company. The electric lighting interests of Morristown are owned by the United Electric Company.

SUPT. BROWN is well pleased over the new gas plant of the Mankato (Minn.) Gas and Electric Light Company. Perhaps in time he will furnish us with some details respecting the construction.

THE following notice from Mr. A. E. Forstall, Secy. of the American Gas Light Association, a copy of which has been mailed to every member, explains itself:

"At the last meeting of the Association (see Volume 17 of the 'Proceedings,' pages 254 to 263, inclusive), the Secretary was instructed to communicate with the members and obtain information as to the extent to which the Association Standards for cast iron pipe and fittings were being used by them, and how far they will be willing to go in insisting that the pipe founders supply them with pipe and fittings made according to these Standards. The Secretary was further instructed that, if the answers received from the members warranted such action, he should address an official communication to each of the various pipe founders of the country urging them to adhere to the Association Standards. Please fill out one or other of the inclosed blanks and mail it to me at once, so that I can tell how to act in regard to the second part of the instructions given me by the Association. The Standards referred to can be found illustrated and described in Volume 15 of the 'Proceedings,' pages 75 to 91, inclusive. The chief points in connection with them are: The dimensions of the bell including the shape and dimensions of the lead groove or crease; the distances from center of the fitting to face of the flanges, or bottom of the bells in the fittings, and the number of bolts and the diameter of the bolt circles to be used for the flanges of fittings and flanged pipes. The weight of the pipe can be varied to suit local conditions, the weights given in connection with the Standards being those which experience has shown to give good results, even under the exigencies of distribution in large cities. Please do not neglect this matter but answer promptly and fully. If the Standards are not supported by the members it is much better for the Association to cancel them, since under such circumstances their existence is misleading."

THE inclosed blanks referred to are of two forms, the first of which invites the members to signify whether they approve or do not approve of the Association Standards for cast iron pipe and fittings, and declaring whether or not the signer will insist, when ordering such pipe and fittings, that they be made in accordance therewith. The second one reads:

"I do not approve, in their entirety, of the Standards for cast iron pipe and fittings, as adopted by the American Gas Light Association in 1898, and would suggest that following changes be made for the reasons given."

THE authorities of Fort Smith, Arkansas, have granted the right to operate an opposition gas works in that city to L. F. Sherwood, of Wichita, Kansas, and Wharton Cornell, of Fort Smith.

MR. PAUL CHALLIS has resigned from the service of the Adrian (Mich.) Gas Company to accept a responsible position with the Battle Creek (Mich.) Gas Company.

MR. JAMES C. ERNST has been elected President of the Covington (Ky.) Gas Light Company.

THE American Bridge Company will furnish the steel work amounting to 3,000 tons of metal for the new Astor building to be erected at the corner of 55th street and 5th avenue, New York city. The Bridge Company is also under contract to furnish about 2,000 tons of the same sort of material for the new Custom House in this city.

THE mix-up in the affairs of the Erie (Pa.) Gas Company resulted in the election of the following Board of officers: Directors, H. L. Moore, S. L. Shirk, E. Rilling, M. J. Fegarty and J. B. Arbuckle; President, H. L. Moore; Vice-President, J. B. Arbuckle; Secretary and Treasurer, S. L. Shirk.

THE people of Chelmsford, Mass., a brisk and handsome suburb of Lowell, are anxious to have the Lowell Company supply them with gas.

JOSEPH B. WOODRUFF, of Chicago, has applied to the authorities of Harvey, Ills., for the right to construct and operate a gas works. He agrees to sell gas at the rate of $1 per 1,000.

THE new gas rate at New Haven, Conn. ($1.10 per 1,000 gross, $1 net), is going to largely increase its business. The discount of 10 cents takes effect on bills paid within 10 days of their presentation.

ARTICLES of consolidation of the Tonawanda (N.Y.) Gas Light Company, the Standard Gas Company, of North Tonawanda, and the Niagara Light, Heat and Power Company have been filed. The name of the consolidated enterprise is that of the Niagara Light, Heat and Power Company, and its capitalization is $75,000 of 6 per cent., non-cumulative preferred stock and $125,000 of common stock. The Directors are: Frederick Wende and John W. Fisher, of Buffalo, N. Y.; George P. Smith and Horatio S. Wende, of Tonawanda, N.Y.; and Edwin R. Ford, of Akron, Ohio.

So far the syndicate which is attempting to secure control of the properties of the Worcester (Mass.) Gas Light Company, has met with scant encouragement. In fact there is little likelihood that there will be any change in its ownership.

THE people behind the projected Gas Company for Groton, Conn. (Messrs. W. H. Allen, of Hartford, and Ralph H. Denison, of Groton), say they are in earnest over the proposition. This place is a post township of New London county, Conn., and bounded by the Long Island sound and the Thames river, which stream separates it from New London. It contains the villages of Groton, Noank, West Mystic, and Poquonock Bridge. Fort Griswold is also within its limits. The population of the township is about 8,000.

THE latest proposed opposition gas concern for Paterson, N. J., appears under the name of the Silk City Gas Company. It is capitalized in the sum of $1,000,000, of which $500,000 is said to have been paid in.

AT a recent meeting of the Common Council, of Dover, N.J., the rules were suspended, and Mr. Ely, of the Dover, Rockaway and Port Oram Gas Company, spoke in favor of the franchise for which he had applied. After some discussion it was decided to defer the matter to a future meeting of the Board, as the Council made some demands which could not be granted except by action of the Directors of the Company. Among the changes which the Council wanted in the proposition was that the rate per 1,000 cubic feet be made $1.25, instead of $1.50, with 16⅔ per cent. discount for prompt payment; option of purchasing the plant by arbitration at the expiration of 10 years, or at any time thereafter on giving 6 months' notice; that the Company should put in 12 miles of pipe the first year, and that after the first year they must, upon application, extend their mains to reach a connection not over 300 feet distant, or to a number of connections where the total distance would not exceed 300 feet for each connection, the Company to do all piping to the building within 50 feet of the curb at its own expense, also from the main."

THE Board of Gas and Electric Light Commissioners has assented to an increase of $150,000 in the capital stock of the Lowell (Mass.) Gas Company, and fixed the selling rate thereof at $200 per share.

AT a meeting of the Directors of the Waynesboro (Pa.) Gas Light Company Mr. John Wolff was elected Treasurer, vice Mr. J. H. Stoner, resigned. Mr. T. B. Smith, Secretary of the Company, was also appointed its General Manager. It was also decided to erect a new holder, to be eventually in two lifts. The offices of the Company are to be established in the structure locally known as the "Dr. A. S. Bonebrake building."

A SPECIAL election will be held in Clinton, Ia., the 19th inst., to determine whether or not a new franchise, to run for 25 years, shall be granted to the Clinton Gas Light and Coke Company. There is no opposition to the proposed grant.

THE following is from the San Francisco *Chronicle*, of Feb. 26th: "The intimations which have been spread that Claus Spreckels would not proceed with his gas project were reduced to nothing yesterday by his announcement that contracts had been entered into by the Independent Gas and Power Company for a plant and mains. One of these contracts is with the United Gas Improvement Company, of Philadelphia, for the installation of a water gas plant of an ultimate capacity of 12,000,000 cubic feet per diem, and the other with an Alabama firm for 8,000 tons of mains and piping. The works will be located on the site of the old sugar refinery, on Tennessee and Louisiana, 22d and 23d streets, and will be constructed in six sections of the capacity of 2,000,000 feet each. Under the terms of the contract with the United Gas Improvement Company the first of these sections is to be in working order by January 1st next, and the remaining sections as the growth of the business of the Independent Gas and Power Company shall require. Claus Spreckels says that the price of the Independent Company's gas will in no event exceed $1 per 1,000 cubic feet, and may be under that figure. The chances are, therefore, that the new Company will not invade the territory of the Equitable Gas Light Company, extending generally north of O'Farrell street to the bay and west of Montgomery street to Van Ness avenue, as that corporation's price is also $1 per 1,000. Competition will naturally be directed—at least at the outset—to the field where the San Francisco Gas and Electric Company and the Pacific Gas Improvement Company have hitherto had undisputed sway."

THE boilers of the Petaluma (Cal.) Gas and Electric Light Company are to be again fired by means of crude oil. The first trial of the oil scheme, made some months ago, was a failure.

THE latest proposition for an opposition gas works in Denver, Col., the infancy of which is under the sponsoring of James C. Burger and D. C. R. Brown (the latter is a resident of Aspen), with the leading features of the proposition, as shown in the application to the Board of Aldermen for a franchise, seem to be these: The projectors agree to sell gas for illuminating purposes at not to exceed $1.10 per 1,000 cubic feet, and for heating and power use at 95 cents per 1,000, prompt payment to entitle the user to a rebate of 10 per cent. Within 18 months the Company must have put down at least 10 miles of main pipes, the mileage to be increased to 50 within 5 years. The Company must pay 3 per cent. of its gross revenue into the city treasury each year. The city, at the end of 5, 10, 15 or 19 years, may elect to buy the plant, after proper notice, the purchase to be made under specified ways for appraisal and condemnation. The plant or franchise rights may not be sold to any company engaged in similar line of business. A forfeit of $10,000 is arranged for, should the Company not begin construction work as provided for.

THE proprietors of the Vineland (N. J.) Light and Power Company, have entered into a contract with Messrs. R. D. Wood & Co., of Philadelphia, for the erection of a single-lift gasholder, up to the storing of 40,000 cubic feet. It is to rest in a steel tank. The holder is to be completed by June 13th.

THE new Liberty street bridge, to be built by the Pennsylvania Railroad Company at Pittsburg, Pa., will be furnished by the American Bridge Company.

THE Columbia (S. C.) Gas Company has been awarded the contract for the lighting of the public buildings, which have for some time been lighted by incandescent electric lamps, eked out by a few arcs. Some of the buildings in the list thus affected are: The State House, the Governor's mansion, State Hospital for the Insane, and several halls of the South Carolina College. Under the old practice the electric lighting of the buildings was carried out by means of a flat rate for the service—$2,700 per year; but the Company declined to go on with the work, virtually asking for a meter system, which proposition was declined by the authorities.

THE new plant of the gas division of the Fond du Lac Street Railway and Light Company, of Fond du Lac, Wis., is quite complete. It is on coal gas lines. The Company proposes to put out several hundred gas ranges this season.

The Market for Gas Securities.

The wiseacres of the local daily press, in so far as their leagued wisdom over gas matters is concerned, seem to have reached the conclusion that the properties of the Consolidated Gas Company of New York are worth quite some money. Those in the actual business of gas trading have had that idea for a great many years, and in their knowledge thereof have profited accordingly; but the foregoing sentences are prompted by the admissions recently made in one daily reflector of thought that the Consolidated Company's real property in New York city is worth $20,000,000! It undoubtedly is. The marked appreciation in Consolidated values for the week, as shown by the Exchange quotations, we thoroughly believe mirrors the approach of an open revealment of the practical union of the lighting companies of New York and Brooklyn, with the former figuring as the overtaker. The advance in the shares of each to virtually the same footing looks like proof. The listed figures show what a marked increase has occurred between now (March 8th) and last Friday.

The general gas share list is strong, particularly in respect of Lacledes, and Peoples, of Chicago. Baltimore Consolidated shows no change from a week ago. Bay State has increased to "one," bid.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.
16 WALL STREET, NEW YORK CITY.
MARCH 11.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	209⅛	210½
Central Union, Bonds, 5's.	3,000,000	1,000	108½	109½
Equitable Bonds, 6's	1,000,000	1,000	105	.
" 1st Con. 5's	2,300,000	1,000	120	
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	294	296
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co. .. Bonds, 5's	11,000,000	1,000	108¾	109
Northern Union, Bonds, 5's.	1,250,000	1,000	104	104¼
New York and East River Bonds 1st 5's	3,500,000	1,000	106	106⅜
" 1st Con. 5's	1,500,000		115	.
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	
Standard	5,000,000	100	130	132
Preferred	5,000,000	100	148	150
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	114
Yonkers	299,620	500	130	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	207	210
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	1	1⅛
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works,..	450,000	100	22	24
" 1st Mtg. 5's	503,000	1,000	96½	99½
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	8	10
" " Bonds, 5's	5,250,000	1,000	76½	77½
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati G. & C. Co.	8,500,000	100	194	198
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	215	216
Consolidated, Baltimore	11,000,000	100	59½	.
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12	16
" Con. Mtg. 5's	380,000	1,000	80	85
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	88	89
" Prior Lien 5's	4,737,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	100	101
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
" Bonds	2,000,000	..	55	
Grand Rapids Gas Lt. Co..	1,000,000	50	103	105
" 1st Mtg. 5's	1,225,000	1,000	..	..
Hartford	750,000	25	240	250
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	45	55
" Bonds, 6's	2 650,000	..	94¾	96
Jackson Gas Co.	250,000	50	70	75
" 1st Mtg. 5's	265,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	101½	103
Laclede, St. Louis	8,271,000	100	80¾	81
Preferred	2,500,000	100	97	100
Bonds	10,000,000	1,000	108½	109
Lafayette Gas Co., Ind.	1,000,000	100	.	.
Bonds	1,000,000	1,000	56	59
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co.	400,000	100	63	65
" 1st Mtg. 6's	350,000	1,000	102½	108
" 6 per cent. scrip, due 1910	100,000	25	87	89
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	103
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	103⅜	103¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	105

Advertisers' Index.

GAS ENGINEERS.

	Page
Wm. Henry White, New York City	395
Fred. Bredel, Milwaukee, Wis.	382
Geo. R. Rowland, New York City	393
The Western Gas Construction Co., Fort Wayne, Ind.	400
Humphreys & Glasgow, New York City	393
American Gas Co., Phila., Pa.	382
David Leavitt Hough, New York City	382
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	379
Baxter & Young, Detroit, Mich.	392
United Gas Improvement Co., Phila., Pa.	387
James T. Lynn, Detroit, Mich.	392
A. E. Boardman, Brevard, N. C.	392
The Jeffrey Manufacturing Co., Columbus, O.	397

GAS WORKS APPARATUS AND CONSTRUCTION.

Continental Iron Works, Brooklyn, N. Y.	394
Deily & Fowler, Phila., Pa.	396
Kerr Murray Mfg. Co., Fort Wayne, Ind.	392
Stacey Mfg. Co., Cincinnati, Ohio	395
Bartlett, Hayward & Co., Baltimore, Md.	393
Davis and Farnum Mfg. Co., Waltham, Mass.	392
R. D. Wood & Co., Phila., Pa.	394
Isbell-Porter Company, New York City	394
Fred. Bredel, Milwaukee, Wis.	382
United Gas Improvement Co., Phila., Pa.	387
National Gas and Water Co., Chicago, Ills	389
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	379
The Western Gas Construction Co., Fort Wayne, Ind.	400
Humphreys & Glasgow, New York City	391
American Gas Co., Phila., Pa.	382
Logan Iron Works, Brooklyn, N. Y.	396
Riter-Conley Mfg. Co., Pittsburgh, Pa.	395
Baxter & Young, Detroit, Mich.	392
American Bridge Co., New York City	378
G. Shepard Page's Sons, New York City	392
James T. Lynn, Detroit, Mich.	392
A. E. Boardman, Brevard, N. C.	392
Sutherland Construction & Improvement Co., N.Y. City	379
Christopher Cunningham, Brooklyn, N. Y.	384
The Jeffrey Manufacturing Co., Columbus, O.	397
Quintard Iron Works, New York City	376

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md.	393
United Gas Improvement Co., Phila., Pa.	387
Burdett Loomis, Hartford, Conn.	394
National Gas and Water Co., Chicago, Ills.	389
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	379
The Western Gas Construction Co., Fort Wayne, Ind.	400
Humphreys & Glasgow, New York City	384
Sutherland Construction & Improvement Co., N.Y. City	379
B. E. Chollar, St. Louis, Mo.	378

SCRUBBERS AND CONDENSERS.

R. D. Wood & Co., Phila., Pa.	394
Continental Iron Works, Brooklyn, N. Y.	394
Logan Iron Works, Brooklyn, N. Y.	396
Riter-Conley Mfg. Co., Pittsburgh, Pa.	395

TAR AND CARBONIC ACID EXTRACTOR.

The Western Gas Construction Co., Fort Wayne, Ind.	400

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich.	390
American Gas Company, Phila., Pa.	382
The Western Gas Construction Co., Fort Wayne, Ind.	400

GAS METERS.

John J. Griffin & Co., Phila., Pa.	360
American Meter Co., New York and Philadelphia	399
Helme & McIlhenny, Phila., Pa.	399
D. McDonald & Co., Albany, N.Y.	397
Nathaniel Tufts Meter Co., Boston, Mass.	398
Maryland Meter and Mfg. Co., Baltimore, Md.	398
Metric Metal Co., Erie, Pa	399
Keystone Meter Co., Royersford, Pa.	398
Detroit Meter Company, Detroit, Mich.	399

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia	399
John J. Griffin & Co., Phila., Pa.	360
D. McDonald & Co., Albany, N. Y.	397
Helme & McIlhenny, Phila., Pa.	399
Nathaniel Tufts Meter Co., Boston, Mass.	398

GAS AND WATER PIPES.

M. J. Drummond & Co., New York City	384
R. D. Wood & Co., Phila., Pa.	394
Warren Foundry and Machine Co., New York City	384
Donaldson Iron Co., Emaus, Pa.	384
Christopher Cunningham, Brooklyn, N. Y.	384
Cornell & Underhill, New York City	384

PIPE WRENCHES.

Atlas Pipe Wrench Company, New York City	384

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N. Y. City	390

GAS TAPPING MACHINES.

George Light, Dayton, O.	397
H. Mueller Manufacturing Company, Decatur, Ills	390

GAS COALS.

Penn Gas Coal	391
Perkins & Co., New York City	390
Despard Gas Coal Co., Baltimore, Md.	391
Westmoreland Coal Co., Phila., Pa.	391
Berwind-White Coal Mining Co., New York and Phila.	390

CANNEL COALS.

Perkins & Co., New York City	390

CONVEYORS.

The Link-Belt Machinery Co., Chicago, Ills	381
The Western Gas Construction Co., Fort Wayne, Ind.	400
The Jeffrey Manufacturing Co., Columbus, O.	397

GAS ENRICHERS.

Standard Oil Co., New York City	351
The Sun Oil Co., Pittsburgh, Pa.	391

COKE CRUSHER.

C. M. Keller, Columbus, Ind.	391

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y.	381

GAS GAUGES.

The Bristol Co., Waterbury, Conn.	381

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City	389
Isbell-Porter Co., New York City	394
R. D. Wood & Co., Phila., Pa.	394
Wm. M. Crane Co., New York City	381

CEMENTS.

C. L. Gerould, Galesburg, Ills	388

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J.	388
Adam Weber Sons, New York City	388
Laclede Firebrick Mfg. Co., St. Louis, Mo.	388
Cyrus Borgner, Phila., Pa.	388
James Gardner, Jr., Co., Pittsburgh, Pa.	388
Henry Maurer & Son, New York City	388
Baltimore Retort and Firebrick Co., Baltimore, Md.	388
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	388
Brooklyn Firebrick Works, Brooklyn, N. Y.	388
Missouri Firebrick Co., St. Louis, Mo.	388

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md.	393
Fred. Bredel, Milwaukee, Wis.	382
J. H. Gautier & Co., Jersey City, N. J.	388
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	388
Adam Weber Sons, New York City	388
Missouri Firebrick Co., St. Louis, Mo.	388

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City	394
Continental Iron Works, Brooklyn, N. Y.	394
Logan Iron Works, Brooklyn, N. Y.	396
R. D. Wood & Co., Phila., Pa.	394

CHIMNEY CONSTRUCTION.

Adam Weber Sons, New York City	389

INCANDESCENT GAS LAMPS.
Welsbach Company, Gloucester, N.J. ... 386
Kern Incandescent Gas Light Co., New York City. ... 380

BURNERS.
C. A. Gefrorer, Phila., Pa. ... 394
Wm. M. Crane Co., New York City ... 341
D. M. Steward Mfg. Co., Chattanooga, Tenn. ... 381

LAVA GAS TIPS.
D. M. Steward Mfg. Co., Chattanooga, Tenn ... 381

STREET LAMPS.
Welsbach Street Lighting Co., New York and Phila. ... 386
Thos T. W. Miner, New York City ... 390

PURIFIERS.
R. D. Wood & Co., Phila., Pa. ... 384
Stacey Mfg. Co., Cincinnati, O. ... 378

PURIFYING MATERIALS.
Connelly Iron Sponge and Governor Co., New York City 389

VALVES.
Ludlow Valve Manufacturing Co., Troy, N.Y. ... 381
R. D. Wood & Co., Phila., Pa. ... 394
Continental Iron Works, Brooklyn, N. Y. ... 394
The P. H. & F. M. Roots Co., Connersville, Ind. ... 383
Isbell-Porter Co., New York City ... 393
The Western Gas Construction Co., Fort Wayne, Ind. ... 400
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 392

EXHAUSTERS.
The P. H. & F. M. Roots Co., Connersville, Ind. ... 383
Isbell-Porter Company, New York City ... 394
Connelly Iron Sponge and Governor Co., New York City 389
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 382

ELECTRICAL APPARATUS.
Wm. Henry White, New York City ... 395

ENGINES AND BOILERS.
The Hazelton Boiler Company, New York City ... 390

PURIFIER SCREENS.
John Cabot, New York City ... 381

GAS STOVES.
American Meter Co., New York and Philadelphia ... 385
Maryland Meter and Manufacturing Co., Baltimore, Md. 398
Keystone Meter Co., Royersford, Pa. ... 398
Nathaniel Tufts Meter Co., Boston Mass. ... 398
George M. Clark & Co., Chicago, Ills. ... 376
Wm. M. Crane Co., New York City ... 377
Detroit Stove Works, Detroit-Chicago ... 335

GASHOLDER TANKS.
J. P. Whittier, Brooklyn, N. Y. ... 393

GASHOLDERS.
Bartlett, Hayward & Co., Baltimore, Md. ... 393
Continental Iron Works Brooklyn, N. Y. ... 394
Deily & Fowler, Philadelphia, Pa. ... 396
Davis & Farnum Mfg. Co., Waltham, Mass. ... 382
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 382
Stacey Mfg. Co., Cincinnati, Ohio ... 395
R. D. Wood & Co., Philadelphia, Pa. ... 394
Logan Iron Works, Brooklyn, N. Y ... 396
Riter-Conley Mfg. Co., Pittsburgh, Pa. ... 395

STORAGE TANKS.
Christopher Cunningham, Brooklyn, N. Y. ... 384

GAS SECURITIES.
Henry Marquand & Co., New York City ... 376

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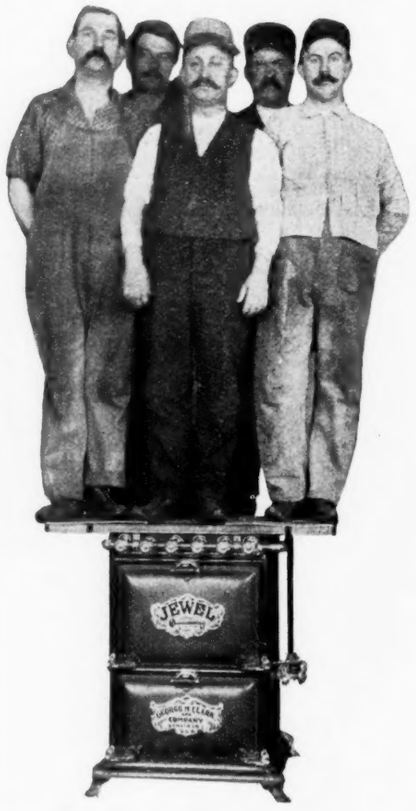

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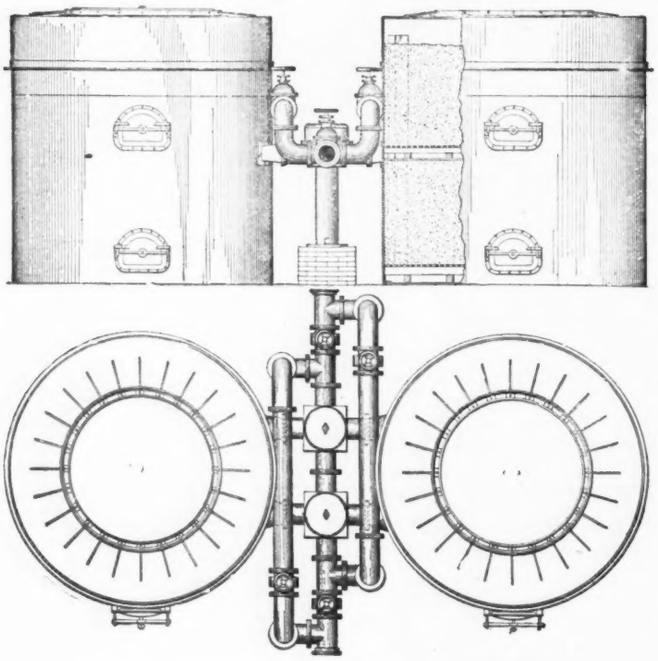

CHOLLAR'S SYSTEM OF GAS PURIFICATION.

Covered by Five U. S. Patents.

In operation, revivification of the oxide is effected by repeated reversals of the direction of the flow of the gas through the beds (in the two boxes used under this system there are eight different routes for the gas to take) whereby the purified gas is made to revive the oxide in parts of the apparatus while the foul gas is fouling it in others.

The boxes are charged or discharged from the sides as well as the top.

There are no Hydraulic Cups or heavy covers.

Either end of the apparatus is inlet or outlet at pleasure.

The capacity is increased five-fold or more over ordinary methods without addition to building.

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Windsor Street Works, Birmingham, England	2,000,000
Saltley Works, Birmingham, England	2,000,000
Colchester, England	300,000
Birkenhead, England	2,250,000
Swindon (New Swindon Gas Company), England	120,000
Saltley Works, Birmingham, England (Second Contract)	2,000,000
Windsor Street Works, Birmingham, England (Second Contract)	2,000,000
Halifax, England	1,000,000
Toronto	250,000
Ottawa	250,000
Toronto (Second Contract, Remodeled)	2,000,000
Lindsay (Remodeled)	125,000
Belleville	250,000
Ottawa (Second Contract)	250,000
Brantford (Remodeled)	200,000
St. Catherine's (Remodeled)	250,000
Kingston, Pa.	125,000
Montreal	500,000
Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract)	250,000
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000
Colchester, England (Second Contract)	300,000
York, England	750,000
Rochester, England	500,000
Kingston, Ont.	300,000
Crystal Palace District, England	2,000,000
Duluth, Minn.	300,000
Caterham, England	150,000
Enschede, Holland	150,000
Leicester, England	2,000,000
Buenos Ayres (River Platte Co.)	700,000
Burnley, England	1,500,000
Kingston-on-Thames, England	1,750,000
Accrington, England	500,000
Tonbridge, England	300,000
Stretford, England	500,000
Oldbury, England	300,000
Saltley Works, Birmingham, England (Third Contract)	2,000,000
York, England (Second Contract)	750,000
Rochester, England (Second Contract)	500,000
Newport, Monmouth, England	250,000
Todmorden, England	500,000
Tokio, Japan	1,000,000
Nelson, British Columbia (Complete Gas Works).	

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Clifton Springs, N.Y., 2 orders.
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Tarrytown, N.Y., 3 orders.
Ft. Henry, N. Y.
Gainsville, Fla.
Hollidaysburg, Pa.
Waterville, N. Y.
Huntington, L. I.
Lexington, Mo.
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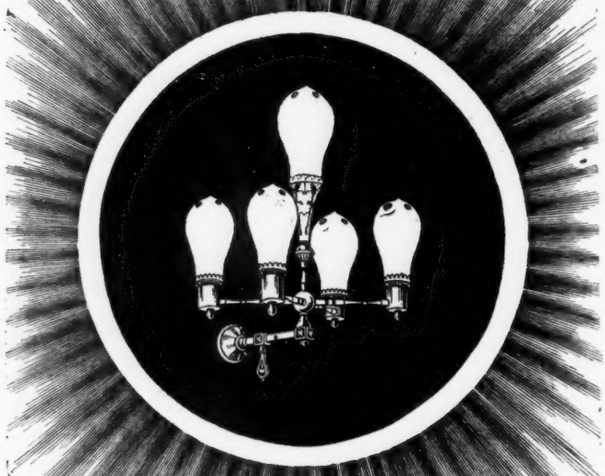

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SAVES 80 PER CENT. OF YOUR GAS BILL.

THE NEW DISCOVERY.
BURNS ONE CUBIC FOOT OF GAS PER HOUR.

No Chimneys to Break. Mantles do not Blacken. Better than Electricity, and only 1-10th the Cost. Not a mere statement, but a Guarantee.

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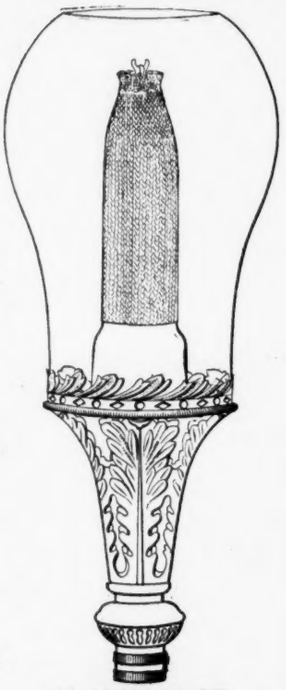

35 TO 40 CANDLES PER CUBIC FOOT.

Burner No.	0	consumes	8-10	cubic foot,	30-candle	power.
"	1	"	1	"	35	"
"	2	"	2	cubic feet,	70	"
"	3	"	3	"	105	"
"	4	"	4	"	140	"
"	7	"	7	"	225	"

Prices Reasonable. Catalogues on Application. Agents Wanted.

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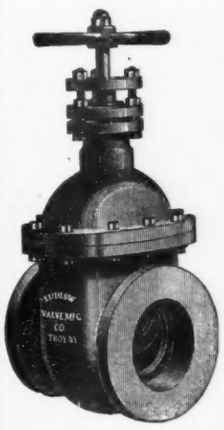

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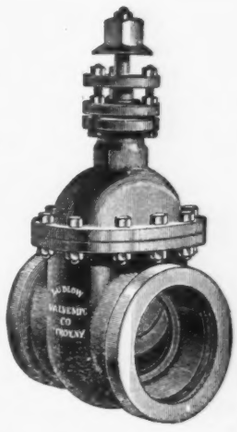
Gas, Water, Steam, Oil, Ammonia, Etc.



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PRESSURE GAUGE.
For continuous records of
Street Gas Pressure.
Simple in construction, accurate in operation, and low in price.
Fully Guaranteed. Send for Circulars.
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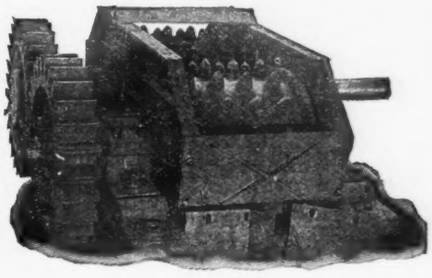

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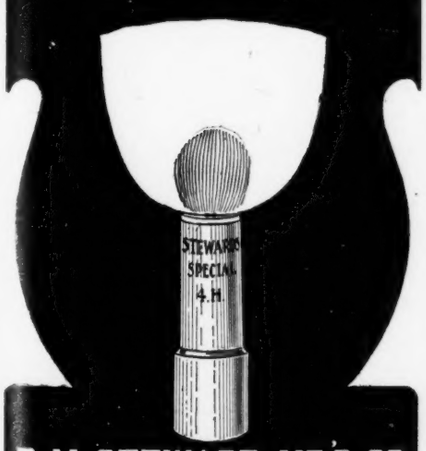
Machinery designed and erected to suit existing conditions and available space
CATALOGUE UPON APPLICATION

A WELL SHAPED FLAME TO A GAS MAN IS AS REFRESHING AS A GLASS OF WINE TO THE LAYMAN



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THE "VULCAN" GAS CONTROLLER
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For all kinds of gas, including acetylene.
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Made in three sizes.
List Price, ¾-inch, $4.50; 1¼-inch, $5.50; 2-inch, $8.
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FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

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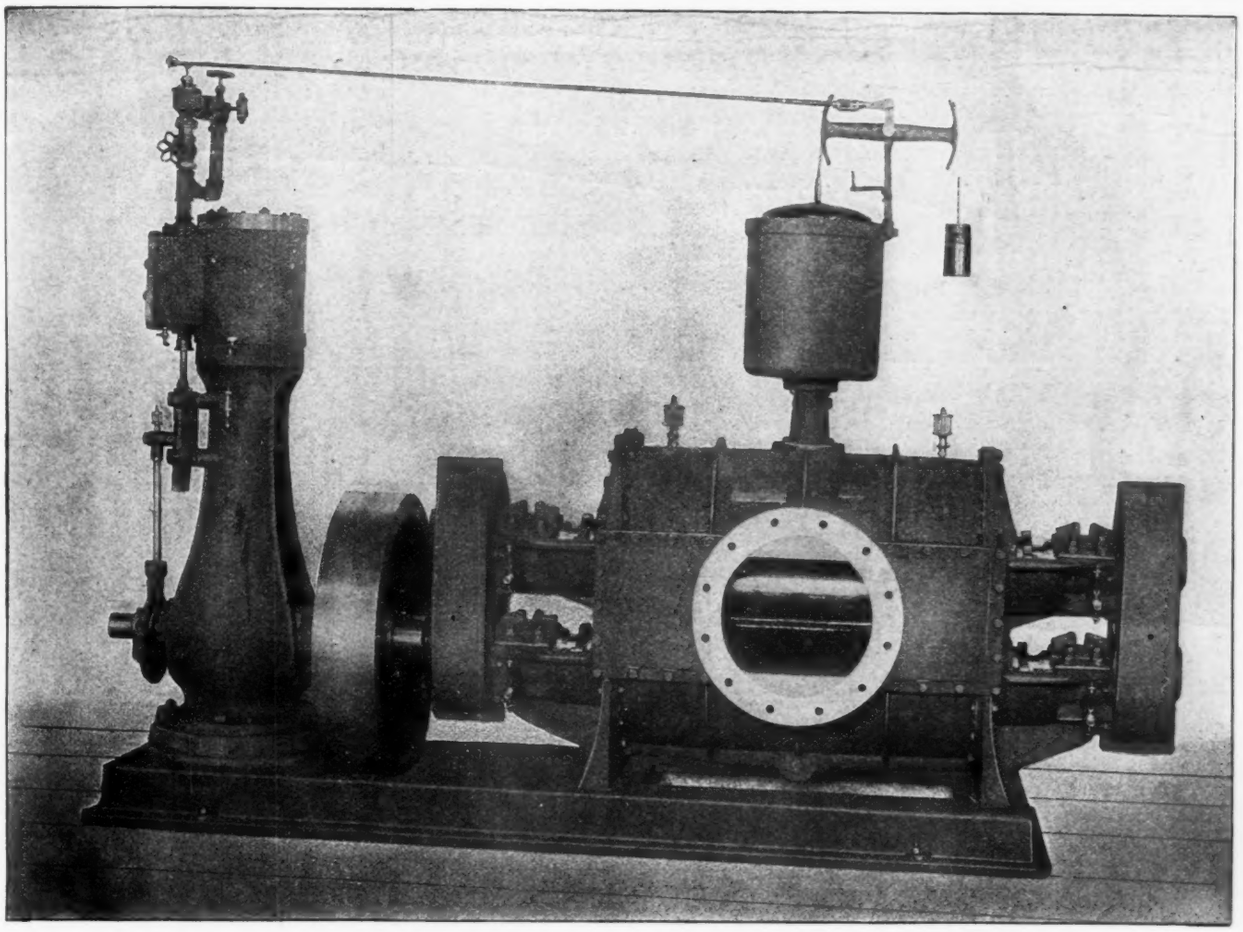
OUR GAS GOVERNOR IS MAKING FRIENDS EVERY DAY.



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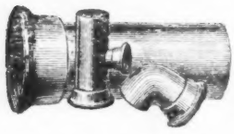

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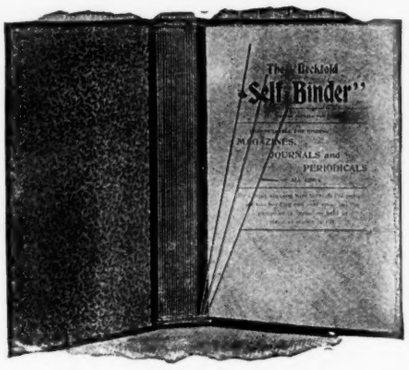

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THE ATLAS PATENT PIPE WRENCH.

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Quick, Effective, Positive in adjustment. The good qualities of Chain Pipe Wrench and Screw Wrench combined, without having the faults of either. Send for our illustrated folder. We believe it will convince you the Wrench is at least worthy of a trial.

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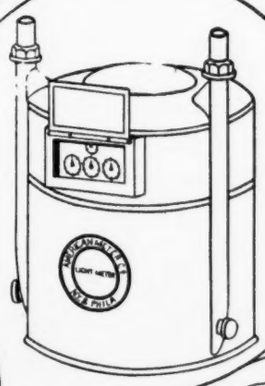

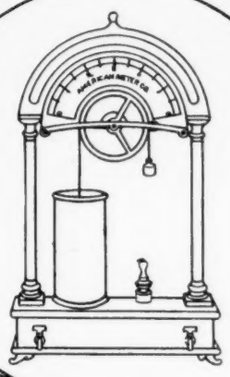

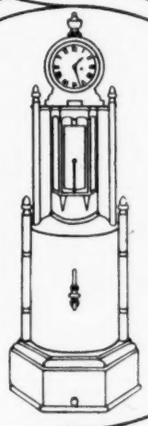

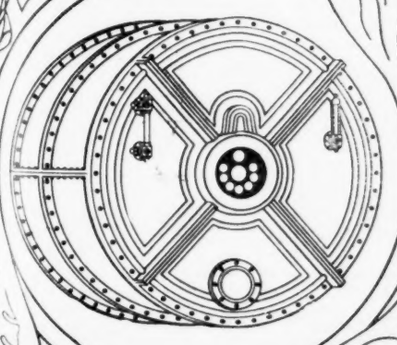

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NEW YORK AND PHILADELPHIA,

CHICAGO, ST. LOUIS,

SAN FRANCISCO.

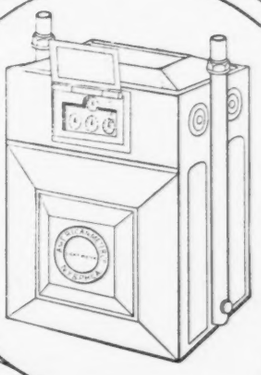
PUBLIC LIGHTING TABLE.

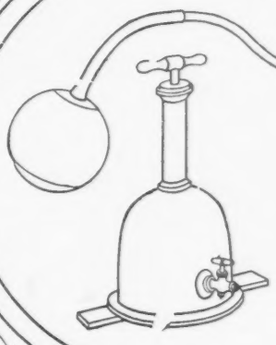
MARCH, 1901.

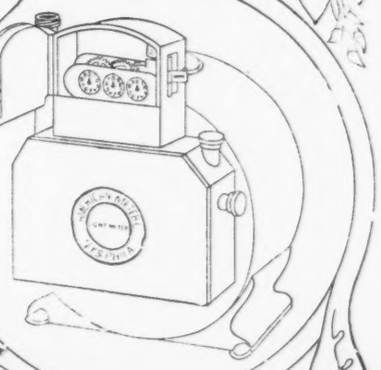
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Fri.	1	3.40 AM	5.40 AM	5.30	5.45
Sat.	2	4.20	5.40	5.30	5.45
Sun.	3	No L.	No L.	5.30	5.45
Mon.	4	No L. FM	No L.	5.30	5.45
Tue.	5	No L.	No L.	5.40	5.25
Wed.	6	6.30 PM	8.30 PM	5.40	5.35
Thu.	7	6.30	9.30	5.40	5.35
Fri.	8	6.30	10.30	5.40	5.35
Sat.	9	6.30	11.20	5.40	5.35
Sun.	10	6.30	12.20 AM	5.40	5.35
Mon.	11	6.30	1.10	5.40	5.35
Tue.	12	6.30	2.00	5.50	5.20
Wed.	13	6.30 LQ	2.50	5.50	5.20
Thu.	14	6.30	3.40	5.50	5.20
Fri.	15	6.30	4.20	5.50	5.20
Sat.	16	6.30	5.00	5.50	5.20
Sun.	17	6.40	5.00	5.50	5.20
Mon.	18	6.40	5.00	5.50	5.20
Tue.	19	4.40	5.00	6.00	5.10
Wed.	20	6.40 NM	5.00	6.00	5.10
Thu.	21	6.40	5.00	6.00	5.10
Fri.	22	6.40	5.00	6.00	5.10
Sat.	23	6.40	5.00	6.00	5.10
Sun.	24	6.50	4.50	6.00	5.10
Mon.	25	11.30	4.50	6.00	5.10
Tue.	26	12.20 AM FQ	4.50	6.10	4.55
Wed.	27	1.10	4.50	6.10	4.55
Thu.	28	1.40	4.50	6.10	4.55
Fri.	29	2.20	4.50	6.10	4.55
Sat.	30	2.50	4.50	6.10	4.55
Sun.	31	3.20	4.50	6.10	4.55

TOTAL HOURS LIGHTING DURING 1901.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	220.10	January	423.20
February	192.30	February	355.25
March	180.00	March	355.35
April	158.30	April	298.50
May	140.40	May	264.50
June	135.40	June	234.25
July	138.00	July	243.45
August	156.20	August	280.25
September	174.40	September	321.15
October	202.30	October	374.30
November	220.40	November	401.40
December	241.30	December	433.45
Total, yr.	2161.10	Total, yr.	3987.45







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Welsbach Street Lighting Company

.... OF AMERICA ....

No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in seventy-five Cities and Towns.

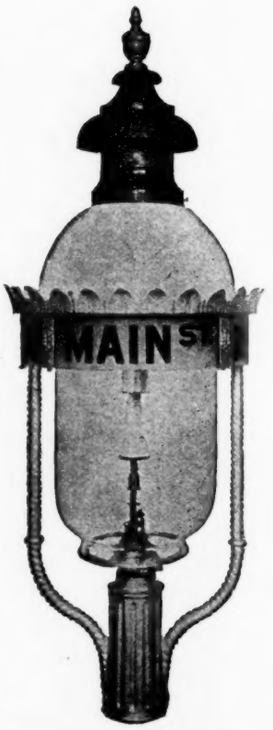
By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.



No. 38.

Correspondence solicited from Gas Companies and others interested in Municipal and outside lighting.

Welsbach Famous Mantles.

THE INCOMPARABLE

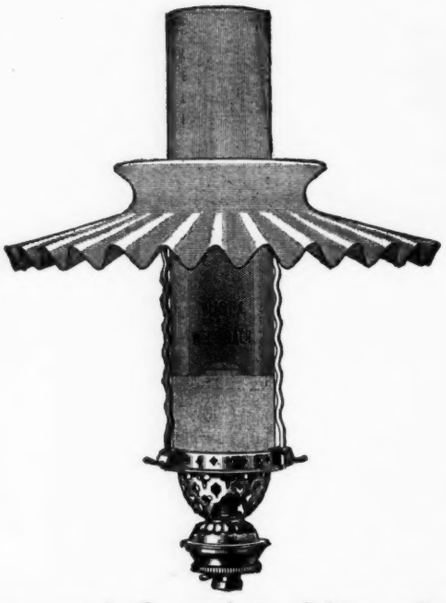
"Yusea" Welsbach Mantle

FINEST EXAMPLE

OF INCANDESCENT

GAS LIGHT

EVER EXHIBITED.



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—AND—

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The Lowest Cost.

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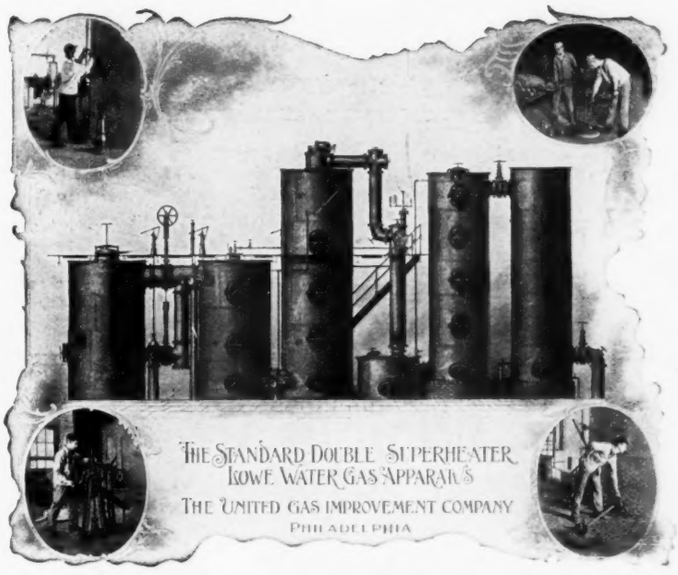
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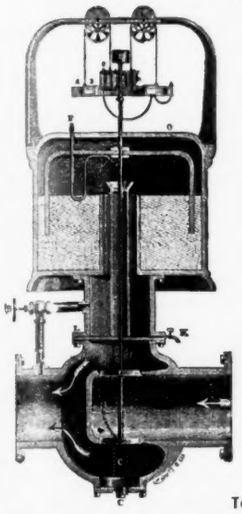

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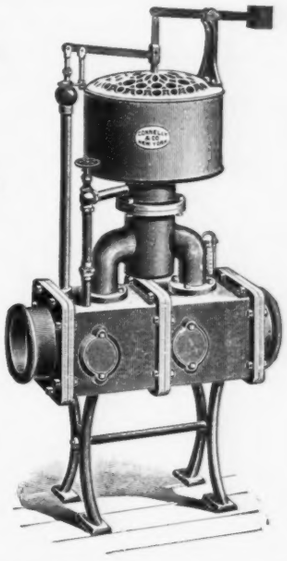

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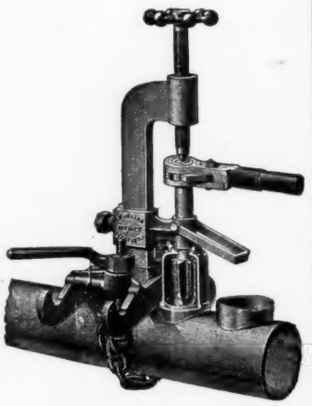

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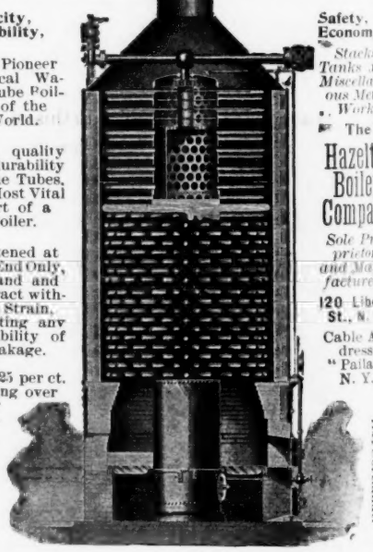

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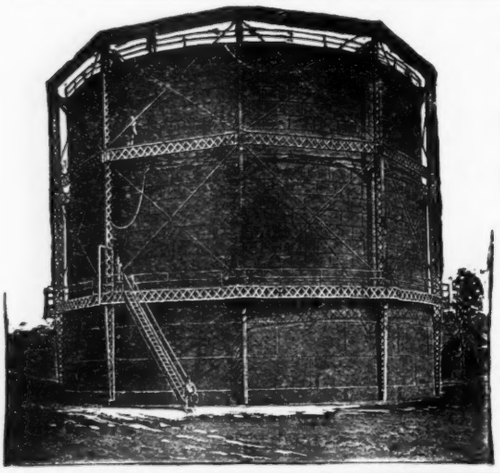

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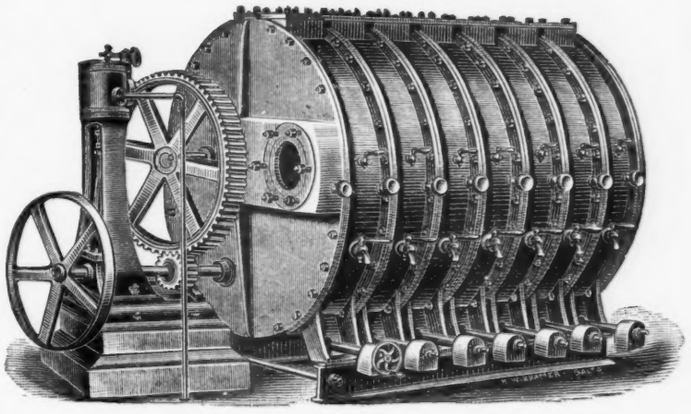

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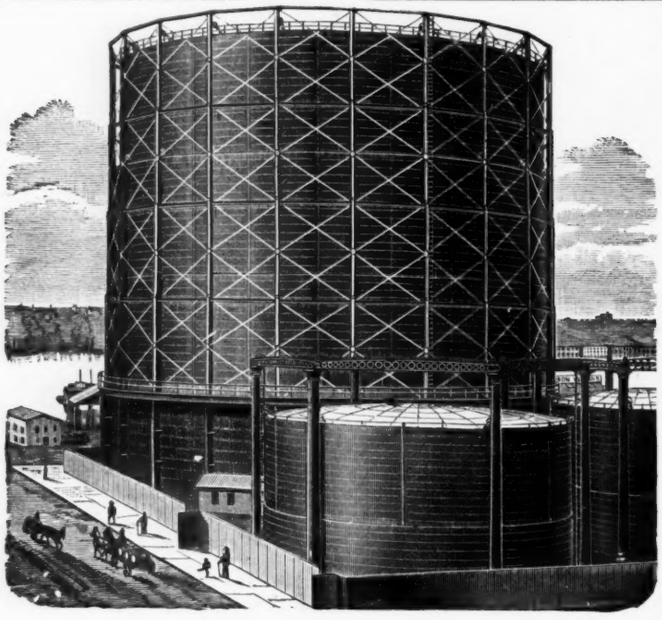

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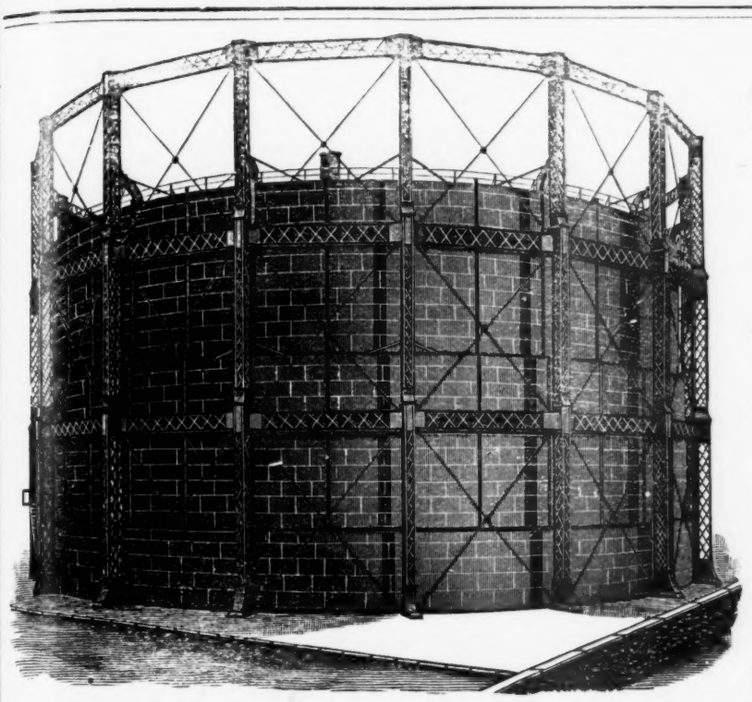

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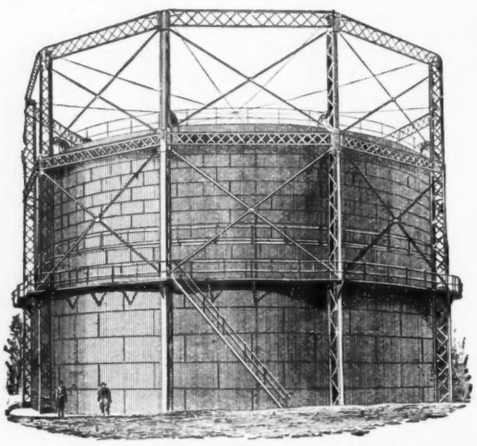

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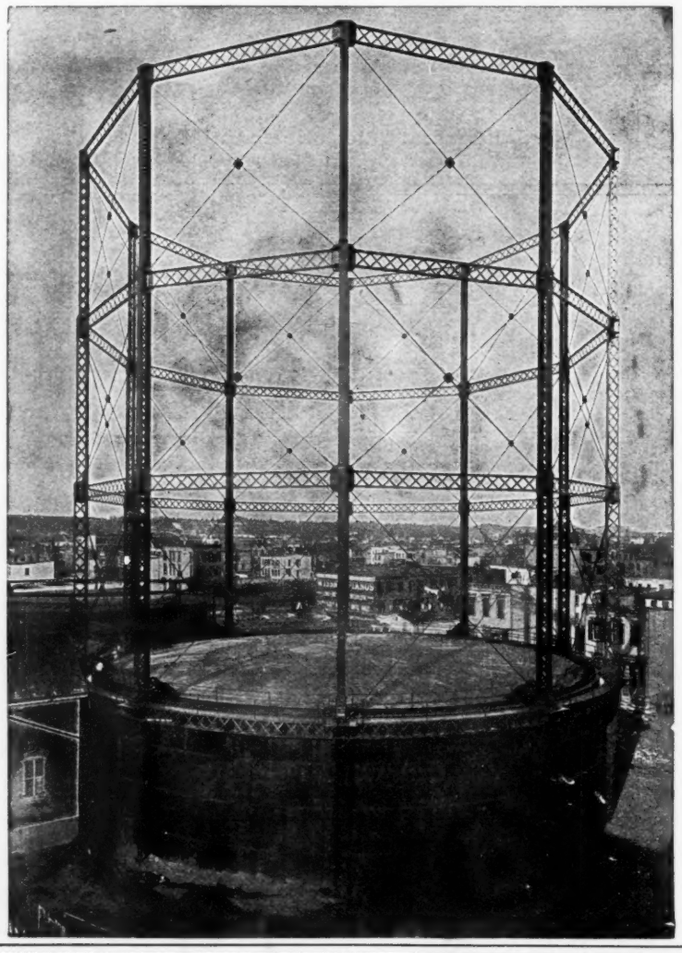

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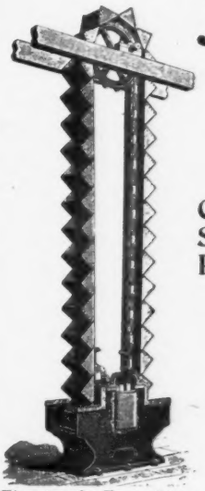

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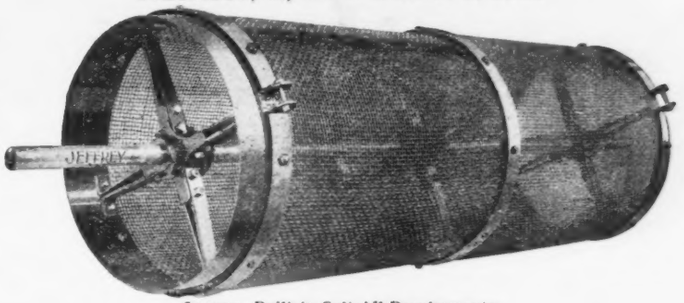

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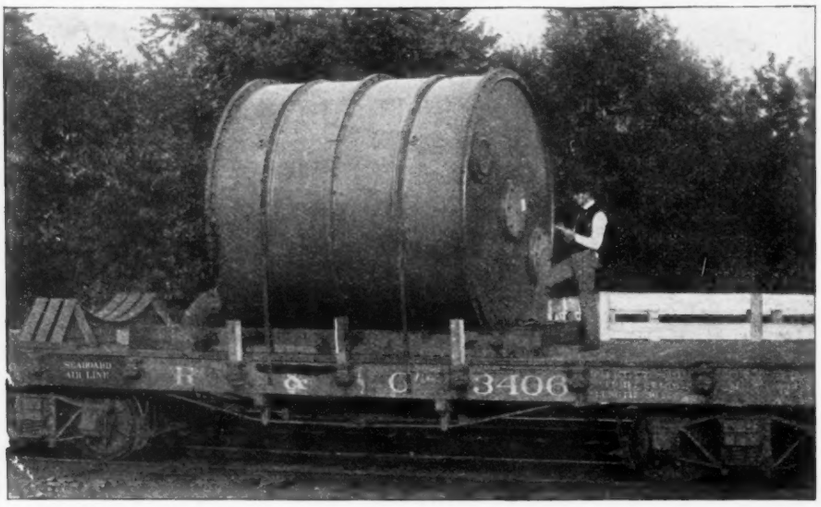

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